Clearinghouse

REPORT

MEDIUM TRANSFORMER DEPARTMENT

COMPUTER APPLICATIONS

DECEMBER 1, 1959 **R59MS350**

INTEGRATED SYSTEMS PROJECT

GENERAL ELECTRIC

NEW YORK, N. Y.

FOR USE OF GE EMPLOYEES ONLY

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TECHNICAL INFORMATION SERIES

Title Page

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ABSTRACT: A highly integrated main line system is described which automatically converts customer orders into factory operator instructions. The system covers the applications of a Burroughs 205 computer to engineering, drafting, operation planning, purchasing, and production control work. Sample inputs and outputs are included along with various computer flow charts and auxiliary records.

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GOV. CLASS.	New York, New York	44

CONCLUSIONS: This integrated main line system uses advanced systems design concepts including regeneration, input-output integration, curve fit time standards, and others. The system has proved in operation the validity of these concepts and shown many of their potential advantages.

INFORMATION PREPARED FOR _____

TESTS MADE BY _____

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SECTION Materials Service LOCATION New York, New York

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Purpose of Integrated Systems Planning Clearinghouse Reports

In an effort to provide the General Electric Company with the results of various department's experimentation with advanced systems planning concepts, it has been decided that descriptions of their operating systems would prove quite useful.

These reports cover the work performed by the operating department indicated. Services serves merely as reporters and there is no intention of indicating that Services has necessarily in any way contributed to the work described.

If you would like to have further information concerning the system detailed in this report, please contact the Services reporter who is shown as the author. He will make the necessary arrangements for appropriate department contacts to clarify or expand on any of the points of interest.

Medium Transformer Department
Clearinghouse Report #1

Product and Facilities

The Medium Transformer Department has facilities to produce $60,000,000 of business and is now operating at a $30,000,000 level, employing over 1,000 people in a plant of 610,000 square feet. The product lines include both liquid and dry type units in the 112-1/2 7500 KVA range. There are eleven (11) of these product lines which have at least some significantly different design and manufacturing elements.

Approximately one-third of the employees are direct labor, one-third on indirect manufacturing (1/2 hourly, 1/2 salary) and the balance is distributed throughout the other functions. The plant was completed in 1954 and exhibits strong integration from quite basic raw materials through to finished product. In spite of product line difference, the plant is laid out to provide the basic flow as a function of major component, rather than individual product line. Figure 1 illustrates the major subsection areas.

All finished units are manufactured to specific customer order though virtually all purchased parts are procured to stock in anticipation of actual orders. Most manufactured parts and sub-assemblies are not stocked but are prepared to specific job numbers. Because of the physically integrated nature of the shop and good control practices, the total delivery cycle is kept to five to ten weeks depending upon the particular type of unit.

The annual turnover on raw and in-process inventory is about four to five times.

Computer Systems Work

The initial computer system work began in September, 1956, under the direction of J. C. Dutton, Manager - Advanced Product Engineering. It operated on a unified study team basis until January 1, 1959, when the systems designers and programmers were reassigned to their parent functions. The operating costs include $134,000 per year for a Burroughs 205 computer with a cardatron and various peripheral devices. The computer is operated by the Finance Section for the Department.

The approach has been to do the engineering, drafting, and manufacturing operation planning by product line. The original installation was for one line. Currently, two more lines are being debugged and will be operating by January, 1960. A fourth line which is now being programmed is targeted for completion by April, 1960. Next, two more lines will be programmed. This will cover 40% of the units and 40% of the dollars.

In contrast to many departments, the Medium Transformer Department has concentrated on automating the data processing associated with the more non-standard lines. As a matter of fact, there is some question in their minds as to the economic practicality of automating the standard lines, using present computing facilities, in terms of design, drafting or operational planning savings.

The principle of regeneration has been used exclusively in the engineering, drafting, and manufacturing operational planning areas. The feeling is that this is the only way automation of these areas for their type of business can pay large dividends. In addition to the activities noted above, work has been done on automating purchasing, stock ledger controls, and payroll.

Cores on all product lines are now designed by the computer and operational planning produced on a second run basis. All the copper and aluminum wire is automatically planned on the computer, which includes operations for drawing, rolling, annealing, formexing, paper covering or glass insulating.

Present activities are coordinated by the operations integration council of which Mr. Harold Parker is Chairman. There are six members: Engineering, Drafting, Manufacturing, Data Processing and Financial, Marketing and Employee Relations. Actual systems planning and programming are done by each section individually.

The Manager - Materials has a Supervisor - Manufacturing Procedures and Programming reporting to him. He is responsible for all manufacturing information, processing systems work including manuals, and operating instructions for mechanized and computerized applications. There are five specialist-programming in this unit.

The Burroughs 205 is a general purpose computer having four magnetic tape units for input - output. Through use of the cardatron (a multiple buffering unit) punched cards can be read in or produced and printed reports prepared with variable format control, while the machine is computing. Special features of the machine include addressable tape with searching in parallel with internal computer operations. The machine configuration at Rome rents for $10,100 per month.

Engineering Design

A customer order (normally preceded by a proposition and quotation) is received in the Production Control Unit of the Materials Sub-section of Manufacturing. Production Control forwards it to Marketing where a requisition data sheet (Exhibit 1) is prepared.

The requisition data sheet is forwarded to Engineering where a design specification input sheet is prepared (Exhibit 2). There is a maximum of ninety-five pieces of input information which describe the customer specification and include drawing list number, job number, etc., for record purposes. Approximately fifteen minutes is required to fill out the input sheet. This information is keypunched into eleven different cards which become the computer input.

The engineering design is produced to obtain the lowest cost design with a minimum amount of material and is referred to as an optimum design. It is estimated that a material and labor savings of $250,000 per year will be realized when the presently planned computer designs are complete.

Design data is not stored for future use. A regenerative program is used for all designs.

The "building block" programming approach has been used in the engineering design - dividing the complete program into a number of sub-programs (see Exhibit 3).

In general, it requires four to seven iterations to complete the design of the core and coils. After a design is completed, it is a frequent practice (on about 50% of the orders) to evaluate a design using the next larger and next smaller core or different types of windings.

There were 120 sub-programs written for the first product line design. Approximately 80,000 computer instructions were required for the complete program. The computer running time varies between thirty minutes and one hour for each design. (This includes set-up time.) The program processes the design from start to finish under the control of an assembly and control program which loads the computer memory (drum) with the proper sub-programs. There is no manual intervention.

The major output from the engineering design program is the transformer calculation and drafting instructions sheets (Exhibit 4). These pages describe the basic product, component characteristics, performance data and customer information and provide a permanent record for engineering. This record is retained for reference and will be used if spare parts are ever required.

A relative cost summary is also part of the output. This is used for comparison of one design against another. An exhibit of the relative cost summary is not included, because it could be misinterpreted by anyone not thoroughly familiar with the use of the data.

Engineering design changes are introduced every two weeks and this presents a maintanance problem. The changes require about one man full time to maintain the Engineering-Drafting programs.

The first product line required about six man-years to program with a staff having no previous programming experience. Since many of the "building blocks" programmed for the first line had been programmed in such a way to make them applicable to other lines, and since the staff was more experienced, the next two lines required about 2.5 man-years.

Not all orders can be fully processed on the computer. The present operating experience with the first product line results in 75% being 100% designed by computer; 15% partially designed (core and coils only) with the mechanical design being done manually, the remaining 10% are manually designed. The decision to split as above is based on economics; it is felt that a program to design all units on the computer would be more costly than permitting manual intervention on the more complex designs. The computer prints out a design summary sheet stating why it was unable to complete a particular design.

Since this is essentially an integrated main line system, the key output is an intermediate magnetic tape which contains the input required for the drafting program. The magnetic tape storage required for each design is fourteen blocks of twenty words each or a maximum of 2800 decimal digits or 1400 alphanumeric characters.

The bulk of the engineering design program consists of formulas that generally involve nothing much more than the standard arithmetic operations. However, there are occasional log functions and elements of the form e^x. Trigonometric functions are not used. The 205 tape logic provides addressable tape capable of being searched both backward and forward with simultaneous search-compute; therefore, search time is kept to a minimum. It is estimated that tape read time requires 45% of the total time and compute time is about 55%.

A problem that concerns the Engineering section as well as the other sections is the desire to be able to switch machines without the necessity for reprogramming.

Drafting Documentation

Drafting programs prepare a series of major component part lists detailing the parts required to meet the engineering specifications that were stored on magentic tape (Exhibit 5). These major components include: core, windings, winding insulation, clamps, base, tank, etc. There a maximum of twenty-one of the major first level parts lists. All sub-level parts lists (up to three additional levels) are prepared manually, and the tracing masters are stored for reproduction.

The first level parts lists are regenerated since they include a listing of the variable dimensions for each part. Each new parts list that is made has a tracing (the first copy of a four-part form) that is stored in the reproduction section. The tracing is used for reference purposes and for spare part orders. If a parts list has been previously produced, the routine only regenerates the copies for Manufacturing, but not a new tracing file copy. Indicative drawing numbers are used on selected parts lists. When indicative drawings are used, a record is maintained on magnetic tape which indicates whether or not the tracing has previously been produced.

The individual parts and assemblies are supported by configuration drawings which contain the fixed dimensions and code letters for the variable dimensions (Exhibit 6). These dimensions may be tabulated on the drawing where only two or three different configurations exist. The additional variable dimensions have their values listed on the parts list for each item. Some of the reasons for providing some tabulated dimensions on the drawing are to simplify programming, reduce program maintenance and reduce computer running time. Careful consideration is given to the dimensions that are permanently placed on the drawing; otherwise this approach could sacrifice some flexibility in automatic part detailing.

The drafting logic for each parts list is described in a series of special data drawings (Exhibit 7). The data drawings format the parts list and cover

the calculation of each variable dimension. The data drawings serve as the model for the computer programming. Most of the programs require a great deal of branching and decision making with about 25% calculation. There is a considerable amount of print record set up to actually prepare the parts list.

Engineering produces four core cards that are used for the integrated drafting-manufacturing core run. This run is independent of the balance of the drafting run.

In addition to the four core cards, the engineering program produces a "search card" and a "do-it" card. The "search" card locates the drafting input on magnetic tape, and the "do-it" card designates which parts lists are to be produced. If the job is not a 100% engineering computer design, the "search" and "do-it" cards are prepared manually.

The drafting program for one product line requires approximately 80,000 instructions. It took ten man-years to plan and program the first product line. This includes the time spent preparing minimum-maximum design layouts, detail drawings, data drawings and programs. The drafting run requires about twenty minutes per unit and does not require any multi-part iteration.

Manufacturing Planning

For single phase units, the manufacturing planning run is directly integrated with the drafting run though this will be a separate pass on the three phase non-LTC units. In the manufacturing planning run, each part's drafting information is used as input to develop material specifications and

size, time standards (set-up and operation times) for each station as well as operator pay class, station number, etc. Each part is designated as to whether floor stock or make to job number (F or M). All this information is printed adjacent to the drafting parts list data (line for line) on what is called a floor parts list (see Exhibit 8). All floor stock parts are identified by a straight identification number with no variable dimensions included on the parts list. Essentially, every purchased part is carried on a stock basis so that each is uniquely defined by its identification number. Some common purchased materials are fully described in English instead of by an identification number.

At present, approximately 2,800 items are carried as a raw material or purchased parts stock and some 1,200 items are carried as manufactured parts stock.

The next step in the manufacturing planning is the writing of a travel book for each "make" part and assembly (see Exhibit 9). This takes up to 300 ten digit words per travel book master. An operator receives an instruction card, a floor parts list copy, a blueprint (in many cases, standard prints are stored in book form at work stations) and when required, a special instruction sheet (see Exhibit 10), such as on the Wiedemann Press and at the Electric Eye Burn Out Stations. A punched card voucher is prepared for each operation (by computer) and turned into payroll by the dispatcher when the man completes the operation (see Exhibit 11).

It takes about twenty minutes per requisition to do the complete manufacturing planning. The logic is contained in a series of data sheets and flow charts, (see Exhibit 12) which when programmed takes over 50,000 instructions to cover the single phase transformers, all cores and wire. MTS is not used in Rome; rather, "curve fit" formulas have been developed by the sub-section methods and time standards men for each operation element. (see Example #2)

Purchasing

This is a routine not directly integrated with the main line design and operational planning. A Flexowriter coupled to an 026 key punch is used to prepare approximately 13,000 purchase orders per year (see Exhibit 13). Punched paper tape is stored for each vendor and item. These 6,000 to 7,000 tapes are retained in a Shaw-Walker envelope file system which is felt to occupy only one-third of the space required for an equivalent Visi-Record file.

The output punched paper tape is used to prepare an arrival card and an expedite card. The arrival card serves as the input to the purchasing computer routine (about five minutes daily and twenty minutes once a month for operating time).

All receipts for stock material which deviate by more than 10% from the planned purchased quantity, are posted as over/under shipments. All reports are prepared off line to the computer. These include an open order

status report, a purchase expedite report, overdue orders and buyer order report. In addition, the computer prepares automatically a postal card follow up for acknowledgement verification.

Although this is not a regenerative program, it is the feeling of the Department buyers that probably 95% of the orders could have vendor selected automatically by the computer if the appropriate logic were stored.

Stock Control

The stock control system is not yet operating. It provides for a fully computerized program to perform ledger posting, detect out of control conditions, and prepare reorder recommendations. The program will take about twenty minutes every other day for 500 to 600 inputs, and uses 3,000 instructions.

The inputs include:

1. orders placed.
2. material arrivals, (receiving goods).
3. withdrawals.
4. rejections.
5. inspection report dispositions.
6. adjustments.
7. deletions from stock.
8. additions to stock.

9. return to stock.

10. external sales.

The outputs are:

1. request to purchasing.

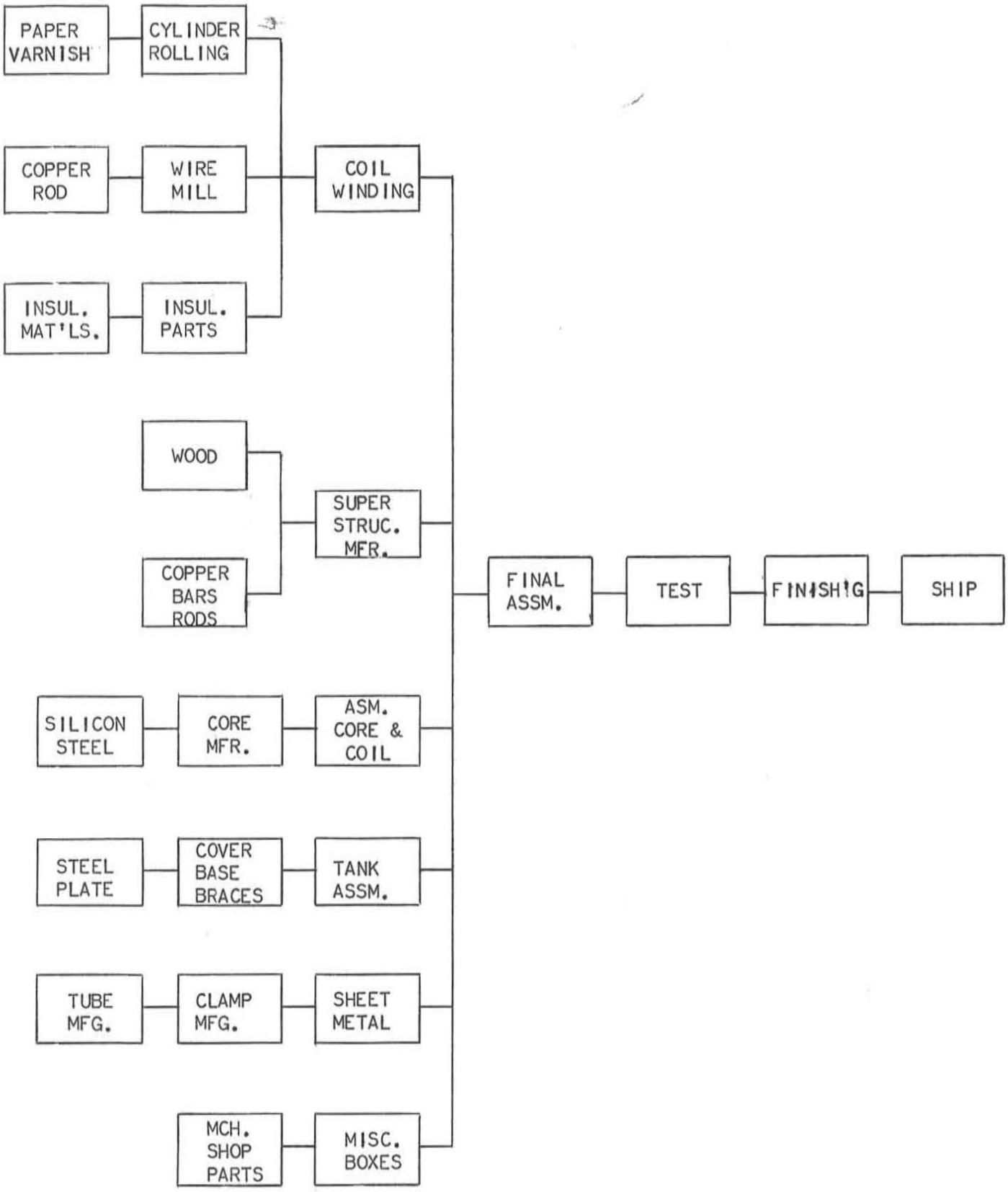
2. periodic stock status summary.

3. ledger action report, over/under stock, low usage.

4. off standard withdrawal report.

Initial operation is planned for 1,800 stock items. Their item code numbers indicate the proper address on magnetic tape. Each item takes sixty 10 digit words for its master record. This is a very complete summary record with the many arithmetic fields generally recorded as floating point numbers. A separate file updating run is performed weekly to adjust master record files. Flow charts and record layouts are available for those who wish them.

Figure 1


PAPER VARNISH
CYLINDER ROLLING
COPPER ROD
WIRE MILL
INSUL. MAT'LS.
INSUL. PARTS
COIL WINDING
WOOD
COPPER BARS RODS
SUPER STRUC. MFR.
SILICON STEEL
CORE MFR.
ASM. CORE & COIL
STEEL PLATE
COVER BASE BRACES
TANK ASSM.
TUBE MFG.
CLAMP MFG.
SHEET METAL
MCH. SHOP PARTS
MISC. BOXES
FINAL ASSM.
TEST
FINISHING
SHIP

REQUISITION DATA SHEET

REQN _____ ITEM _____ QUANTITY _____

PROP _____ RL RS _____

CUSTOMER _____

RATING _____

JOB NO. _____

ENGR _____ WK

OUTLINE _____ WK

D/L _____ WK

SHIP _____ WK

☐ DO NOT SCHEDULE
☐ CUSTOMER'S INSPECTION
☐ PRINT APPROVAL - DO NO OTHER WORK
☐ PRINT APPROVAL - ACCUMULATE MATERIAL
☐ TEST REPORTS
☐ TEST REPORT APPROVAL REQ'D.
☐ SPARE PARTS LIST

HIGH VOLTAGE SECTION

COVER BUSHINGS OR

☐ BOLT PATTERN (TRUNC TRANS)
☐ FULL LENGTH FLANGE
☐ FULL LENGTH AIR TERMINAL COMPARTMENT
☐ JUNCTION BOX (AIR)
☐ AIR SWITCH (MVR) (MVRS)
☐ CUTOUTS
☐ LIQUID SWITCH WITH KEY INTERLOCK
☐ KEY INTERLOCK WITH LV _____ OR _____
☐ ELECTRICAL INTERLOCK WITH LV _____ OR _____

FUSE SIZE _____

POSITION (OPEN-CLOSE _____

ULTIMATE USER _____ LOCATION _____

DETAILS

SHIPPING

☐ EXPORT BOX
☐ GAS FILLED

CONNECT _____

HV CABLE TERMINATIONS

☐ CLAMP TYPE TERMINALS
☐ POTHEAD WITH WIPE SLEEVE (UNCUT)
☐ POTHEAD WITH STUFFING BOX
☐ ACS FITTING INTERLOCKED ARMOR

CABLE O.D. _____

HV CABLE DATA

TYPE _____ 1/C 3/C
SIZE _____ MCM AWG
CABLE FEED ☐ SINGLE ☐ LOOPING
ENTRANCE ☐ ABOVE ☐ BELOW
CONDUIT SIZE NO. OF CONDUITS

TRANSFORMER SECTION

☐ ASA ☐ NEMA ☐ IGE

_____ % IZ

TAPS _____

☐ LTC
☐ IOC OIL ☐ IOCA OIL
☐ PYRANOL
☐ OPEN DRY
☐ SEALED DRY
☐ OUTDOOR ☐ INDOOR
☐ STD ☐ REV ☐ DOUBLE END
☐ FUTURE FANS

PRESERVATION SEALED _____

☐ BOLTED COVER

☐ SPEC. CUST. REQ. APPLY

BUSHINGS

HV		LV
_____	LINE	_____
_____	NEUTRAL	_____
_____	CONNECTORS	_____

BUSHING CT'S	HV	LV	NEUT
PRESENT	☐	☐	☐
FUTURE	☐	☐	☐
NO/BUSH	_____	_____	_____
RATIO	_____	_____	_____
ACC. CLASS	_____	_____	_____

LIGHTNING ARRESTERS

HV		LV
☐	PRESENT	☐
☐	BRACKETS	☐
☐	STATION	☐
☐	INTERMEDIATE	☐
_____	KV	_____

ALARMS

☐ TOP OIL ☐ N/C ☐ EYE LEVEL
☐ LIQUID LEVEL ☐ N/C
☐ PRES. RELIEF ☐ N/C

WINDING TEMP EQUIPMENT

INDICATOR ☐ 1Φ ☐ 3Φ ☐ N/C ☐ EYE LEVEL*
RELAY ☐ 1Φ ☐ 3Φ ☐ N/C ☐ EYE LEVEL
REMOTE ☐ 1Φ ☐ 3Φ

LOW VOLTAGE SECTION

COVER BUSHINGS OR

☐ FULL LENGTH FLANGE TO _____
☐ BOLT PATTERN (TRUNC TRANS) TO _____
☐ JUNCTION BOX
☐ FULL LENGTH AIR TERMINAL COMPARTMENT
☐ BREAKER PANEL IN TERM COMP SEE DETAILS

LV CABLE DATA

TYPE _____ 1/C 3/C
SIZE _____ MCM AWG
CABLES PER PHASE _____
ENTRANCE ☐ ABOVE ☐ BELOW
CONDUIT SIZE _____ NO. OF CONDUITS _____
NEUTRAL

ADDITIONAL DATA:

COPIES TO: _____ ENGINEERING BLDG. 1
MATERIAL SECTION BLDG. 1
PREPARED BY _____ DATE _____
CHECKED BY _____ DATE _____

FORM #411
REVISION #1 2-24-59

SHEET 1 OF _____

ENG DUE ☐ COMPLETE ☐ CORE AND COILS ONLY | WK DL DUE | WK | JN PREP DY:

SPECIFICATION INPUT FOR SINGLE PHASE COMPUTER DESIGN

CARD NUMBER 1 (BLANKS IN COL. NOT NO.)

CARD NUMBER -- T 1/2

FORMAT BAND -- 1/3

* COOLING CODE 1-OA, 2-OA/FA, 3-OA/FUTURE FANS -- 14

* KVA SELF-COOLED (FLOATING POINT INDEX IN 16 & 17) -- 16 17 18 19 20 21 22 23 24 25

** KVA-FA OR FUTURE FANS (FLOATING POINT INDEX IN 27 & 28) -- 27 28 29 30 31 32 33 34 35 36

* LV TEST KV (FLOATING POINT INDEX IN 49 & 50) -- 49 50 51 52 53 54 55 56 57 58

* HV TEST KV (FLOATING POINT INDEX IN 71 & 72) -- 71 72 73 74 75 76 77 78 79 80

CARD NUMBER 2

CARD NUMBER -- T 2/2

FORMAT BAND -- 1/3

* LV VOLTS (FLOATING POINT INDEX IN 5 & 6) -- 5 6 7 8 9 10 11 12 13 14

* HV RATED VOLTS (FLOATING POINT INDEX IN 16 & 17) -- 16 17 18 19 20 21 22 23 24 25

* HV MIN VOLTS (FLOATING POINT INDEX IN 27 & 28) -- 27 28 29 30 31 32 33 34 35 36

* (FLOATING POINT INDEX IN 38 & 39) -- 38 39 40 41 42 43 44 45 46 47

* TO (FLOATING POINT INDEX IN 49 & 50) -- 49 50 51 52 53 54 55 56 57 58

* (FLOATING POINT INDEX IN 60 & 61) -- 60 61 62 63 64 65 66 67 68 69

* HV MAX VOLTS (FLOATING POINT INDEX IN 71 & 72) -- 71 72 73 74 75 76 77 78 79 80

CARD NUMBER 3

CARD NUMBER -- T 3/2

FORMAT BAND -- 1/3

STEP UP OR STEP DOWN OPERATION CODE 0-STEP DOWN, 1-STEP UP -- 14

* PERCENT GUAR IMPEDANCE (FLOATING POINT INDEX IN 16 & 17) -- 16 17 18 19 20 21 22 23 24 25

* GUAR NO LOAD LOSS (FLOATING POINT INDEX IN 27 & 28) -- 27 28 29 30 31 32 33 34 35 36

* REQUIRED CALC SOUND LEVEL (FLOATING POINT INDEX IN 38 & 39) -- 38 39 40 41 42 43 44 45 46 47

* FREQUENCY - 50 OR 60 ~ (FLOATING POINT INDEX IN 49 & 50) -- 49 50 51 52 53 54 55 56 57 58

* GUAR TEMP RISE (FLOATING POINT INDEX IN 60 & 61) -- 60 61 62 63 64 65 66 67 68 69

CUSTOMER REQUIRES PAPER INS ON LV 0-NO, 1-YES -- 80

CARD NUMBER 4

CARD NUMBER -- T 4/2

FORMAT BAND -- 1/3

GUAR % EXC CURRENT AT 100% (FLOATING POINT INDEX IN 5 & 6) -- 5 6 7 8 9 10 11 12 13 14

GUAR % EXC CURRENT AT 105% (FLOATING POINT INDEX IN 16 & 17) -- 16 17 18 19 20 21 22 23 24 25

GUAR % EXC CURRENT AT 110% (FLOATING POINT INDEX IN 27 & 28) -- 27 28 29 30 31 32 33 34 35 36

GUAR % EXC CURRENT AT 117% (FLOATING POINT INDEX IN 38 & 39) -- 38 39 40 41 42 43 44 45 46 47

* GUAR TOTAL LOSS-OA -- 49 50 51 52 53 54 55 56 57 58

** GUAR TOTAL LOSS-FA -- 60 61 62 63 64 65 66 67 68 69

CUSTOMER REQUIRES PAPER INS ON HV 0-NO, 1-YES -- 80

SPECIFICATION INPUT FOR SINGLE PHASE COMPUTER DESIGN

CARD NUMBER 5 (BLANKS IN COL. NOT NO.)

CARD NUMBER -- 1 2 — 5/2

FORMAT BAND -- 3 — 1/3

* REQUIRED TEMP FOR CALC (FLOATING POINT INDEX IN 5 & 6)-- 5 6 7 8 9 10 11 12 13 14

ALR WIRING } ARR LETTERS

* CONTROL CENTER IDENT (ALR WIRING & ARRANGEMENT ONLY) -- 18 19 20

LIMITING DIMENSION CODE 0-NO 1-YES -- 36

D- HT OVER HIGHEST NON-REMOVABLE PART (FLOATING POINT INDEX IN 38 & 39)-- 38 39 40 41 42 43 44 45 46 47

A- OVERALL HEIGHT (FLOATING POINT INDEX IN 49 & 50)-- 49 50 51 52 53 54 55 56 57 58

C- OVERALL WIDTH (FLOATING POINT INDEX IN 60 & 61)-- 60 61 62 63 64 65 66 67 68 69

B- OVERALL LENGTH (FLOATING POINT INDEX IN 71 & 72) -- 71 72 73 74 75 76 77 78 79 80

CARD NUMBER 6

CARD NUMBER -- 1 2 — 6/2

FORMAT BAND -- 3 — 1/3

CUSTOMER REQUIRES FULL VACUUM CODE 0-NO, 1-YES-- 14

PERCENT GUAR EFFICIENCY AT 25% (FLOATING POINT INDEX IN 16 & 17)-- 16 17 18 19 20 21 22 23 24 25

50% 27 & 28)-- 27 28 29 30 31 32 33 34 35 36

75% 38 & 39)-- 38 39 40 41 42 43 44 45 46 47

100% 49 & 50)-- 49 50 51 52 53 54 55 56 57 58

115% 60 & 61)-- 60 61 62 63 64 65 66 67 68 69

PERCENT GUAR EFFICIENCY AT 125% (FLOATING POINT INDEX IN 71 & 72)-- 71 72 73 74 75 76 77 78 79 80

CARD NUMBER 7

CARD NUMBER -- 1 2 — 7/2

FORMAT BAND -- 3 — 1/3

LV SERIES MULT CODE 1=2 TO 1, 3=3 TO 1 -- 14

HV SERIES MULT CODE 1=2 TO 1, 3=3 TO 1 -- 25

GUAR REGULATION AT 1.0 PF (FLOATING POINT INDEX IN 27 & 28)-- 27 28 29 30 31 32 33 34 35 36

GUAR REGULATION AT 0.8 PF (FLOATING POINT INDEX IN 38 & 39)-- 38 39 40 41 42 43 44 45 46 47

* LV BUSHING CODE NO (FIXED POINT)-- 57 58

* HV BUSHING CODE NO (FIXED POINT)-- 68 69

* GUAR SOUND LEVEL (FLOATING POINT INDEX IN 71 & 72) -- 71 72 73 74 75 76 77 78 79 80

CARD NUMBER 8

CARD NUMBER -- 1 2 — 8/2

FORMAT BAND -- 3 — 1/3

CORRECTED RATIO OF LOSSES FOR PRODUCT FACTOR -- 5 6 7 8 9 10 11 12 13 14

INDUCE TEST - STD - 2XNORMAL = 0 NON STD = 1 -- 25

LV "Y" RATING IN VOLTS (FLOATING POINT INDEX IN 27 & 28)-- 27 28 29 30 31 32 33 34 35 36

* NUMBER OF UNITS (FLOATING POINT INDEX IN 38 & 39)-- 38 39 40 41

COVER 0 = WELDED, 1 = BOLTED -- 58

* MUST BE FILLED IN ON EVERY JOB

** MUST BE FILLED IN ON EVERY JOB THAT REQUIRES FAN OR FUTURE FANS

SPECIFICATION INPUT FOR SINGLE PHASE COMPUTER DESIGN — PREPBY:

(BLANKS IN COL NOT NO.)

CARD NUMBER 10

CARD NUMBER — 1/1 0/2

FORMAT BAND — 2/3

JOB NUMBER (START NO. IN COL 4) — 4 5 6 7 8 9 10 11 12 13 14

REQUISITION NUMBER (START NO. IN COL 15) — 15 16 17 18 19 20 21 22 23 24 25 26 27

ENG NOTICE NUMBER (START NO IN COL 28) — 28 29 30 31 32 33 34

D.L. NUMBER (START NO. IN COL 35) — 35 36 37 38 39 40 41 42 43

NAMEPLATE NUMBER (START NO. IN COL 44) — 44 45 46 47 48 49 50 51 52

ROME SPEC NUMBER (START NO. IN COL 53) — 53 54 55 56 57 58 59

CUSTOMER SPEC NUMBER (START NO. IN [illegible]) — 60 61 62 63 64 65 66 67 68 69 70 71 72 73

G.E.I. NUMBER (START NO. IN COL 74) — 74 75 76 77 78 79

SHIPMENT 0 = OIL FILLED-DOMESTIC; 1 = GAS FILLED-DOMESTIC; 2 = OIL FILLED-FOREIGN; 3 = GAS FILLED-FOREIGN — 80

CARD NUMBER 11

CARD NUMBER — 1/1 1/2

FORMAT BAND — 2/3

CUSTOMER NAME (START IN COL 4 & ABBREVIATE IF NECESSARY) — 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37

SERIAL NUMBER(S) (START IN COL 38) — 38 39 40 41 42 43 44 45 46 47

WINDING SPEC NUMBER (START IN COL 48) — 48 49 50 51 52 53 54 55

PRESS RELIEF DL (START IN COL 56 & DO NOT INCLUDE GR. NO.) — 56 57 58 59 60 61 62 63 64

PRESS RELIEF ALARM 0 = NONE; 1 = VISUAL; 2 = ELECTRICAL; 3 = BOTH VISUAL & ELECTRICAL — 65

THERMOMETER DWG. NO. (START IN COL 66 & INCLUDE GR OR PT NO) — 66 67 68 69 70 71 72 73 74 75

LIQUID LEVEL GAGE ALARM 0 = NO ALARM; 1 = WITH ALARM — 76

OXIDE TREAT CORE 1 = YES — 77

NO. OF UNITS TO BE IMPULSED (BLANK IF NONE) — TENS 78 UNITS 79

IMPULSE TEST 0 = NONE; 1 = CUST REQ; 2 = QUALITY CONTROL — 80

CARD NUMBER 12

CARD NUMBER — 1/1 2/2

FORMAT BAND — 3/3

NO. OF UNITS REQUIRING HEAT RUN — TENS 4 UNITS 5

NO. OF UNITS REQUIRING SOUND TEST — TENS 6 UNITS 7

PAINT BLANK = BLUE-GRAY; 1 = LIGHT GRAY; 2 = SPECIAL — 8

COLOR OF SPECIAL PAINT, IF ANY (ABBREVIATE IF NECESSARY — 9 10 11 12 13 14 15 16

NO. OF GAL. OF SPECIAL PAINT — 17 18 19

NO. OF COPIES CERTIFIED TEST REPORTS 0 = NONE — 20 21

SPECIFICATION INPUT FOR SINGLE PHASE COMPUTER DESIGN

CARD NUMBER 12 (CONT) (BLANKS IN COL. NOT NO.)

PHOTOS (BLANK IN COLS 22-27, IF NONE)

INTERNAL FROM H.V. FRONT 1=YES — 22

INTERNAL FROM L.V. FRONT 1=YES — 23

EXTERNAL FROM H.V FRONT 1=YES — 24

EXTERNAL FROM L.V. FRONT 1=YES — 25

OVERHEAD OBLIQUE VIEW OF INTERNAL FROM H.V. SIDE 1=YES — 26

OVERHEAD OBLIQUE VIEW OF INTERNAL FROM L.V. SIDE 1=YES — 27

SPARE PARTS REQUIRED 1=YES — 28

INHIBITED OIL 1=YES — 29

BASE UNDERCOATING REQUIRED 1=YES — 30

COST INSP. REQUIRED: AFTER VACUUM PRIOR TO TANKING = 1
AFTER FINAL ASSEMBLY = 2
AT TEST FOR HEAT RUN ONLY = 3
AT TEST FOR IMPULSE ONLY = 4
AT TEST FOR SOUND LEVEL ONLY = 5
AT TEST FOR ALL TESTS = 6
— 31

NUMBER OF DAYS IN ADVANCE TO NOTIFY CUSTOMER FOR INSPECTION — 32 33 (TENS, UNITS)

SHIPMENT CODE — 34 35

TYPE OF CUSTOMER: 1=UTILITY, 2=INDUSTRIAL, 3=REA, 4=FOREIGN — 36

FISCAL WEEK THAT ENGINEERING IS ISSUED (01 THROUGH 52) — 37 38

YEAR THAT ENGINEERING IS ISSUED — 39 40

DUPLICATE OF SERIAL NO. (START IN COL. 41) — 41 42 43 44 45 46 47 48 49 50

SPECIAL TANK TEST 1=YES — 51

PRINT APPROVAL REQUIRED 1 1=ACCUMULATE MATL BUT DO NO WORK
2=ACCUMULATE NO MATL & DO NO WORK — 52

DATE (MO, DAY, YR) — 53 54 55 56 57 58

HV BUSHING TERMINAL CODE (BLANK = NONE) — 59

LV BUSHING TERMINAL CODE (BLANK = NONE) — 60

PRINTS TO CAP ONLY

MADE BY RR OTTO JAN 24,58

ISSUED [illegible] Mar 4 1958

GENERAL ELECTRIC ROME

278HA134EB

TITLE CALC LOSSES (RATED, GUAR & HEAT RUN) OA & FA, %IR, %IZ & ACCURATE CURRENT DENSITY

CONT. ON SHEET

SH. NO. 1 EOG2

REV

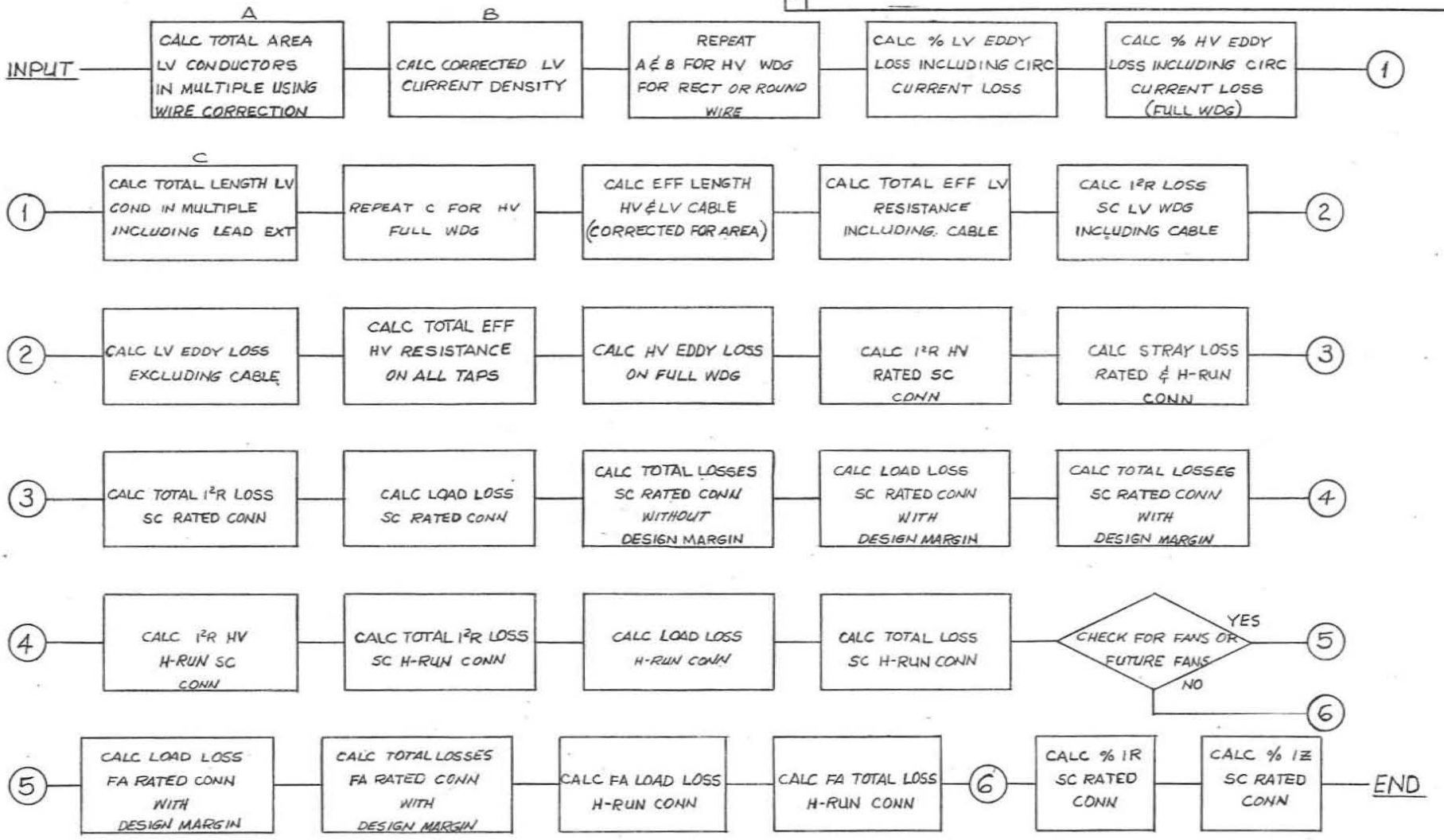


Exhibit 3, Sheet 1

GENERAL ELECTRIC

278HA134EN

CONT ON SHEET 2 SH NO. 1

REV NO.

TITLE

CALC LOSSES(RATED, GUAR., H-RUN,) OA & FA, %IR, %IZ & ACCURATE CURRENT DENSITY

CONT ON SHEET SH NO.

FIRST MADE FOR E062

REVISIONS

PROBLEM: To calc. all losses FA & SC, and %IZ

ENTRY: Via Cub 0000

EXIT: Via Cub 0000 Any 0 Mod "0
(B) = 0000

STATISTICS: Prog. contains 575 words and uses all registers prog is B Modified

SUB-ROUTINES USED: General round-off & $\sqrt{X}$

REMARKS: HV Eddy loss is calculated on full wdg.

Increase in Eddy loss due to cross-flux is included in the stray loss.

1 Aug 21 '58

2

CAP ONLY

PRINTS TO

MADE BY R. Otto, 2-28-58

ISSUED W. Parker Mar. 4, '58

APPROVALS

MED TRANS DIV OR DEPT.

ROME LOCATION

278HA134 EN

CONT ON SHEET 2 SH NO. 1

PRINTS TO CAP 2 ONLY

GENERAL ELECTRIC ROME

278HA134EN

MADE BY W. W. Trask Jan 27, 1958

ISSUED H. A. Parker Mar 9, '58

TITLE CALC. LOSSES (RATED, GUAR & H-RUN) OA & FA, %IR, %IZ & ACCURATE CURRENT DENSITY

CONT. ON SHEET 3 SH. NO. 2

E062

REV

MT. 873 IM 10-57

INPUT REQUIRED	CELL	OUTPUT REQUIRED	CELL
W_{WL} WIRE WIDTH LV	3816	EFF AREA OF LV CONDUCTOR S_1	3900
t_{WL} WIRE THK LV	3817	" " " HV " S_2	3901
W_{WH} WIRE WIDTH HV	3827	% EDDY LOSS LV WDG S_3	3844
t_{WH} WIRE THK HV	3828	% " " HV " S_4	3837
NS_L NO. OF STRANDS LV	3815	TOTAL LENGTH L.V. COND INC. LEAD EXT. S_5	3902
NS_H " " " HV	3829	" " H.V. " " " " S_6	3903
K_C CIRC. I FACTOR FOR HOBART COILS	3934	TOTAL EFF. L.V. RESISTANCE S_7	3904
N_{SPL} NO OF SPACERS L.V. WDG.	3840	TOTAL EFF H.V. RESISTANCE S_8 MAX. INS.	3905
N_{TL} NO. OF TURNS LV WDG.	3768	" - S_9	3906
LV WDG TYPE CODE	0298	" TO S_{10}	3907
HV WDG TYPE CODE	0299	" - S_{11}	3908
N_{SPH} NO OF SPACERS HV WDG	3833	" S_{12} MIN. INS.	3909
N_{THMAX} NO. TURNS HV WDG MAX	3769	" S_{13} RATED INS	3910
-	3770	I^2R HV RATED SC S_{14}	3911
TO	3771	I^2R LV RATED SC S_{15}	3912
-	3772	TOTAL I^2R RATED SC S_{16}	3913
MIN	3773	EDDY LOSS HV RATED SC S_{17}	3914
RATED	3774	" " LV " " S_{18}	3915
He_H EFF STACK HT HV	3858	STRAY RATED SC S_{19}	3916
He_L " " " LV	3857	LOAD " " S_{20}	3917
FREQUENCY	3981	TOTAL " " S_{21}	3918
MLT_L MLT OF LV WDG	3839	LOAD LOSS " " WITH DM S_{22}	3919
MLT_H MLT OF HV WDG	3832	TOTAL " " " " " S_{23}	3920
K_2 ROUND WIRE CODE	3935	LOAD LOSS RATED FA " " S_{24}	3921
LEAD IX	3863	TOTAL " " " " " S_{25}	3922
I_{LSC} LV COIL I S.C.	3813	I^2R HV SC H-RUN CONN S_{26}	3923
I_{HSCMIN} MIN HV ISC	3780	TOTAL I^2R " " " " S_{27}	3924
-	3781	STRAY " " " " S_{28}	3925
TO	3782	LOAD LOSS " " " " S_{29}	3926
-	3783	TOTAL LOSS " " " " S_{30}	3927
I_{HSCMAX} MAX HV ISC	3784	LOAD LOSS H-RUN FA S_{31}	3928
RATED HV ISC	3785	TOTAL " " " " S_{32}	3929
%IZ GUAR. SC	3984	L.V. CURRENT DENSITY S_{33}	3802

PRINTS TO CAP ONLY

GENERAL ELECTRIC
ROME

272HA134EN

MADE BY W. W. Frantz Jan. 27, 1958

ISSUED Mar 9, '58

TITLE CALC LOSSES (RATED, GUAR. & H-RUN) OA & FA, %IR, %IZ & ACCURATE CURRENT DENSITY

CONT. ON SHEET SH. NO. 3

E.062

REV | 1 RUP

MT - 973 1M 10-57

INPUT REQUIRED	CELL	OUTPUT REQUIRED		CELL
DUCT + PB BETWEEN LAYERS OF BBL LV	3877			
%$_{IX_{CC}}$ H-RUN ROB SC	3897	HV CURRENT DENSITY MAX SC	S_{34}	3803
IX_{CF} RATED SC	3862	%IR RATED	S_{35}	3932
IX_{CF} H-RUN SC	3896	%IZ "	S_{36}	3933
NO-MAG CODE NO (NONE = 0, 2" = 1, 3" = 2, PLATE = 3)	3838	LV LEAD LOSS SC (L_L)		3930
KVA SC	3998			
CORE LOSS WITH D.M.	3764			
" " WITHOUT DM	3765			
GUAR. TOTAL LOSS SC	3974			
" " " FA	3973			
SC (1) - FF (3) - FA (2) CODE	3999			
I_{LV} FA	3814			
N_{SECL} NO OF SECTIONS LV	3879			
N_{SECH} " " " HV	3826			
CABLE LENGTH HV	3936			
" AREA "	3939			
" LENGTH LV	3937			
" AREA "	3938			
RATED HV	3991			
MIN HV	3990			
I_{XCC} RATED	3861			
LV COTTON CODE	3778			
HV " "	3776			
LV RADIAL BUILD AVERAGE	3842			
λ_L LV STRAND INS	3777			
λ_H HV " "	3775			

MISCELLANEOUS NOTES

K_C IS MODIFIED BY
PROG. FOR ALL WDGS
EXCEPT HOB COILS
K_2 = 0000 RECT WIRE OR 0-01 ROUND WIRE

JN 21-863583 REQ EN C-863583 DL 429L528 NP 103B3122
RL CUST SPEC GEI 54000 SN C- 863583A-0

HV WDG DWG 429L528BB G2 HV INSUL DWG 429L528BB G1 TREAT G-300 CORE AND COIL
LV WDG DWG 429L528BC G2 LV INSUL DWG 429L528BC G1 TREAT NONE TREAT G-401

CORE SP P SIZE 10-11 DUCT NO BOLTS YES SF .965 CS 67.09 FS .59
WINDOW 36 X 6.00 STEEL SIL. WT 1500 V/T 20.86 INDUCE STANDARD

%EXC	B-KL	W/#	CORR FAC	LOSS-KW	VA/#	%I CALC	%I GUAR	NOISE	DB		
100	117.0	1.05	1.0	2.16	4.71	1.74	2.80	GUAR	58.0	IMPULSE TEST	( )
105	123.0	1.32	1.0		6.97	2.58		REQD	58.0	NOISE TEST	(X)
110	128.5	1.77	1.0		11.34	4.19		CALC	54.7	HEAT RUN	( )

HV WDG TYPE CONT DISK

LINE V	COIL V	LINE I	COIL I	FA LINE I	FA COIL I	RESIS	TURNS	INSUL LEVEL	BIL	TEST
13860	13860	60.1	60.1			.8071	664	LINE	110	34
13530	13530	61.6	61.6			.7879	648			
13200	13200	63.1	63.1			.7699	633			
12870	12870	64.7	64.7			.7506	617	KV BETW SECT 1.58		
12540	12540	66.4	66.4			.7314	601	NO. SPACERS 8		
								WIDTH SPACERS 1.125		

COIL	CONDUCTOR	TOT LNG	WT	EFF A	EFF LNG
ALL	(440X085)F6	2960	420	.03678	2960

MLT 4.45 AMP/SQ IN 1806

BUSHINGS (2) 1B750
LEADS LINE 91/24
COIL 91/24

LV WDG TYPE 2 LAYER BBL

LINE V	COIL V	LINE I	COIL I	FA LINE I	FA COIL I	RESIS	TURNS	INSUL LEVEL	BIL	TEST
2400	2400	347	347			.01808	115	LINE	75	19

CONDUCTOR	TOT LNG	WT	EFF LNG	EFF A		
8(235X124)2W4H F4	3218	354	398	.22816	KV BETW SECT	NO. SPACERS 16
					AMP/SQ IN 1521	WIDTH SPACERS .500

LEADS LINE 550/24 COIL 550/24 MLT 3.44 BUSHINGS (2) 1B749

CUSTOMER FOR EXHIBIT ONLY
RATING (15) OA-60-833-13200-2400/4160Y
TRANSFORMER CALCULATION AND DRAFTING INSTRUCTION

P 1 CONT ON P 2
WS 3384457

Exhibit 4, Sheet1

TANK DATA

TYPE OF SEAL - SEALED TANK 5.0 LB OPER PRESS ( )BRACED FOR FULL VACUUM
COVER (X)WELDED ( )BOLTED

INSIDE DIM 27.5 X 35.0 X 83.0
OIL LEVELS MAX 5.50 25C 8.50 MIN 10.75

TUBE HEADERS HV (6) 5TH AT 5.8 IN SP LV (4) 6TH AT 5.7 IN SP X END ( ) TH AT IN SP
Y END ( ) TH AT IN SP A- 4.5 L- 67 J- 7.5
PRESSURE RELIEF
419C149 G7 WITH MECHANICAL ALARM 553B476BA G1
CONTROL CENTER PER SPG 737 P 38 TYPE 030AA G2
THERMO AL-208 DWG 376D104 P27
LIQUID LEVEL GAUGE DWG 744A949 EA

NAMEPLATE SIZE 11 IN.

FANS ( )FUTURE ( )PRESENT ( ) FANS PER UNIT CAT NO 21HC512Y5 12 IN. 230 VOLTS 1 PHASE

OUTLINE WEIGHTS		DIMENSIONS	
TOTAL	6950	A=	96.00
UNTANKING	2850	B=	40.00
TANK AND FITTINGS	2000	C=	67.00
285 GAL 10-C OIL	2100	D=	87.00

TK PLATE THK .250
SHIPMENT (X)OIL ( )GAS FILLED (X)DOMESTIC ( )FOREIGN

ENG-G DESIGN COMPLETE - SEE SUMMARY SHEET
(X)COMPLETE ( )PARTIAL COMPUTER DESIGN LAYOUT NO. 03-05 DATE 11- 4-59
LOCATION ON ENG-G DUPLICATE TAPE - BLOCKS TO PREP BY EDPM
CKD BY

JN 21-863583 DL 429L528 WDG DWG 429L528 BBG2 INS DWG 429L528 BB G1

DATA DWG 422C201BA J= 32.30 K= 301 L= 16 M= 15 N= 16 R= 16 S= 300

NO. SPACERS 8 T= .375 U= .600 X= .250 A= .093 ER= .625

BREAK DUCT .525 TAP DUCT NO. 21-.375 23-.375 25-.375 27-.375

DUCTS NOT MARKED .150 AXIAL FILL IN DUCTS 6-10-16-22-26-32-38-42

RADIAL FILL COIL

TAPS TO 421C399 FIG NO.11 AND 13A TAP STRAP (2) .75 X.030 QTY 4

COIL CONDUCTOR INS WT/COIL
ALL (440X085) F6

WDG FORM .218 SS ON .156 CYL 15.00 ID X 31.90 LNG

TAP NO. C IN COIL G 3 TURNS FROM INSIDE END COIL RAD BUILD
TAP NO. D IN COIL H 2 TURNS FROM INSIDE END NORMAL 1.274 BARE
TAP NO. E IN COIL K 7 TURNS FROM INSIDE END NORMAL 1.494 MAX.
TAP NO. F IN COIL M 8 TURNS FROM INSIDE END

48 CONT. SECT. 664 TURNS TURNS/SEC= D-13 F-14
G-13 H-13 K-13 M-13

Y-END
D F F F F F F F F F F F F F F F F F F F M H D D G K F F F F F F F F F F F F F F F F F F F F D

RATING (15) OA-60-833-13200-2400/4160Y

HV WINDING
CONT. DISK

PREP BY EDPM
CHKD BY DATE 11- 4-59

ENGINEERING COIL WINDING SPEC. WS 3384457

Exhibit 4, Sht. 3

JN 21-863583 DL 429L528 WDG DWG 429L528 BCG2 INS DWG 429L528 BC G1

DATA DWG 422C201JA J = 32.30
NO.SPACERS 16 X = .250 A = .093 ER = .875 1.125

(.093) CREPE PAPER TAPE PER SIDE ON CONDUCTOR THRU END RING

INCREASE PRS BD FILL EACH SIDE OF TRANSP TO (.562)

STD TRANSP (28.75) TURNS FROM BEGINNING OF EACH SECT IN EACH LAYER (1) TURNS ALLOWED FOR EA TRANSP

CONDUCTOR	INS	WT/COIL	TURNS/LAYER 57.5	RAD BUILD	LAYER	BARE	.527
8(235X124)2W4H/SEC	F4		TOTAL TURNS 115				
TOTAL					TOTAL	BARE	1.335
						MAX	1.380
WDG FORM INNER .250 SS ON .187 CYL 11.00 ID X 31.90 LG					MAX DIA		14.56
WDG FORM OUTER .219 SS ON .062 PB OVER INNER							

RATING (15) OA-60-833-13200-2400/4160Y

LV WINDING
TWO LAYER BBL

PREP BY EDPM
CHKD BY DATE 11- 4-59

ENGINEERING COIL WINDING SPEC WS 3384457

Exhibit 4, Sheet 4

AXIAL BUILDS	HV WDG	
CLAMP		2.750
ENDS		3.163
BRK		.525
4	DUCTS X .375 TAP	1.500
42	DUCTS X .150	6.300
48	SECTS X .446	21.408
	FILL	.354
	TOTAL	36.000

	LV WDG	
CLAMP		2.750
ENDS		2.938
2	SP DUCTS X .562	1.125
	TRANSP	.125
2	COLLS X .062	.125
118	CONDS X .239 1%	28.484
	FILL	.452
	TOTAL	36.000

HEATING	HV	LV	FA HV	FA LV
W/SQ IN	.505	.745		
RISE	14.4	13.0		
DUCT	- .7			
INSUL	- 2.2			
RISE/OIL	11.5	13.0		
EFF OIL	39.7	39.7		
RISE/AMB	51.2	52.7		

CYL NO.	SPEC	THK	ID	LGTH	A
HV 1	A50P501	.156	15.000	31.9	
LV 1	A50P501	.188	11.000	31.9	

KW LOSSES	RATED	DES	GUAR	H RUN	FA	FA DES	FA GUAR
RES HV	3.07	GUAR	GUAR	3.23		DES	GUAR
LV	2.18			2.18		GUAR	
TOTAL	5.25			5.41			
EDDY HV	.08			.08			
LV	.17			.17			
STRAY	.27			.39			
LOAD	5.77	5.77		6.05			
CORE	2.16	2.16	2.35	2.16			
TOTAL	7.93	7.93	8.61	8.21			

CORE HOT SPOT	
W/SQ IN	.779
RISE	19.1
TO INCR	2.9
EFF OIL	39.7
TOTAL	61.7
FORCES	19400
APPROX MAX LL	5.89

RADIAL BUILD

5.500	11.000 ID	
.188	CYL	
.250	OIL	
5.938		
1.335	LV WDG	
7.273		
.045	OB	
7.318		
.182	OIL	
7.500	15.000 ID	
.156	CYL	
.219	OIL	
7.875		
1.274	HV WDG	
9.149		

SC EFF TANK SURF	45600
W/SQ IN	.180
EFF OIL RISE	39.7
TOP OIL INCR	3.2
FA EFF TANK SURF	
W/SQ IN	
OIL RISE	
FAN FACTOR	
EFF OIL RISE	
TOP OIL INCR	

OIL CHANGE/10 .50 IN

GAL PYR 1ST FILL

GAL PYR 2ND FILL

WEIGHTS AND LIQUID		
STEEL		1500
COPPER		774
MISC		576
ABSORBED PYR		
CORE AND COIL		2850
TANK AND FITT		2000
RADIATORS		
EXP TANK		
TOTAL		4850
LIQ MN	285	2100
LIQ EXP		
LIQ RAD		
TOTAL		6950

EFFICIENCY		
LOAD	CALC	GUAR
25	98.72	
50	99.08	
75	99.09	
100	99.00	98.98
115	98.93	
125	98.88	

REGULATION		
P.F.	CALC	GUAR
.80	3.9	4.1
1.0	.9	1.0

CC % REACT	5.27
CF % REACT	.10
LD % REACT	.02
% IR	.72
TOTAL % IZ	5.45
GUAR % IZ	5.50

P 2 CONT ON P 3

TRANSFORMER CALCULATION AND DRAFTING INSTRUCTIONS

WS 3384457

Col. 1

GENERAL ELECTRIC
ROME

FIRST MADE FOR TRANS.

TITLE
CLAMPS

PARTS LIST
428L967EA G1

JN 21-863457 GROUP ISS SHEET 1

REVISIONS

PT.	NAME OF PART	USED WITH	DESCRIPTION	QUAN.
21	BOT CLAMP	(1)31	* P21 A = 7.48 L = 34.20	1
22	BOT CLAMP	(1)32	* P22 A = 7.48 L = 34.20 E = 11.40	1
23	BOT COIL SUPT PLATE	(2)31 (2)32	.375 X 2.50 X .70 STL B4A33F	4
25	COIL SUPT ANG BOT LH	(1)31 (1)32	* P25 L = 4.20	2
26	COIL SUPT ANG BOT RH	(1)31 (1)32	*P26 L = 4.20	2
28	BOT CLP RIB	(2)31 (2)32	.375 X 1.50 X 5 STL B4A33F	4
31	BOT CLP ASM	(1)36	* P31	X1
32	BOT CLP ASM	(1)37	* P32	X1
33	UPRIGHT PLATE	(2)36 (2)37	422C204WE P3	4
34	UPRIGHT	(2)36 (2)37	* P34 M = 17.88 L = 35.74	4
36	UPRIGHT ASM LV		* P36 J = 10 K = 11.43	X1
37	UPRIGHT ASM HV		* P37 J = 10 K = 11.43	X1
41	TOP CLP LV	(1)46	* P41 A = 10.76 B = 11.43 L = 34.20 M = 7.50 N = 5.50	1
42	TOP CLP HV	(1)47	* P42 B = 11.43 L = 34.20 N = 7.50 M = 5.50	1
43	TOP CLP BLK	(2)46 (2)47	.375 X 1.25 X 2.60 STL B4A33F	4
46	TOP CLP ASM LV		* P46	X1
47	TOP CLP ASM HV		* P47	X1
50	BOT OUTER X-CHAN		* P50 L = 21.48	2

REV. NO. * 422C204CB

DDM 10-5-50 PRINTS TO 3B2. TOTAL 2 CONT ON SH 2

▲ Col. I

GENERAL ELECTRIC
ROME

FIRST MADE FOR TRANS.

TITLE
CLAMPS

JN 21-863457

PARTS LIST
428L967EA G1

GROUP | ISS | SHEET 2

REVISIONS	PT.	NAME OF PART	USED WITH	DESCRIPTION	QUAN.
	51	OUTER LEG CLP		* P51	2
	52	OUTER LEG CLP		* P52	4
	53	SHIPPING BRACE		* P53 L = 27.70	2
	57	BOT CLP STUD		.750-10-2AX13.70 THD ENDS 2.26 STL B4A33F	1
	58	TOP CLP STUD		.750-10-2AX13.70 THD ENDS 2.26 STL B4A33F	1
	59	STRAPPING		.035 X 1.25 X 88.50 STL D21Y3C	2
	60	SEAL		SIGNODE STRAPPING CO. CAT. NO. 107	4
	61	CORE LEG STUD		* P61	5
	62	LOCKSTRIP		744A294 P45	10
	63	NUT		747A824 P21	10
	64	CORE REINF PLATE		* P136	2
	65	TOP COIL SUPT LH		422C204WD G41	2
	66	TOP COIL SUPT RH		422C204WD G42	2
	67	SCR HEX HD (SHIP BR)		.625-11X2 STL	4
	70	CLP ASM		422C204TC P21	X1

REV. NO. * 422C204CB

MT-952C

MADE BY EDPM 10- 6-59 ISS. BY EDPM 11-4-1959 PRINTS TO 382. TOTAL 2 CONT ON SH

▲ Col. (

GENERAL ELECTRIC
ROME

FIRST MADE FOR TRANS.

TITLE: BASE

PARTS LIST: 428L967HD G1

JN 21-863457

GROUP | ISS | SHEET 1

REVISIONS

PT.	NAME OF PART	USED WITH	DESCRIPTION	QUAN
21A	PLATE		*P21A A = 38 B = 54 C = 15.75	1
22	JACK PAD		744A207 P110	4
23A	ANGLE		*P23A K = 41 N = 7.50 E = .70	2
25	BUMP PIN		744A211 P21	2
26	GROUND BLK		755A168 G1	2
27	ASM		*P27 A = 51 K = 41 M = 7.47 H = 10.50	X1

REV. NO. *555B102

MT-952C

MADE BY EDPM 10- 6-59 ISS. BY EDPM Oct-13'59 PRINTS TO NONE

CONT. ON SH.

GENERAL ELECTRIC

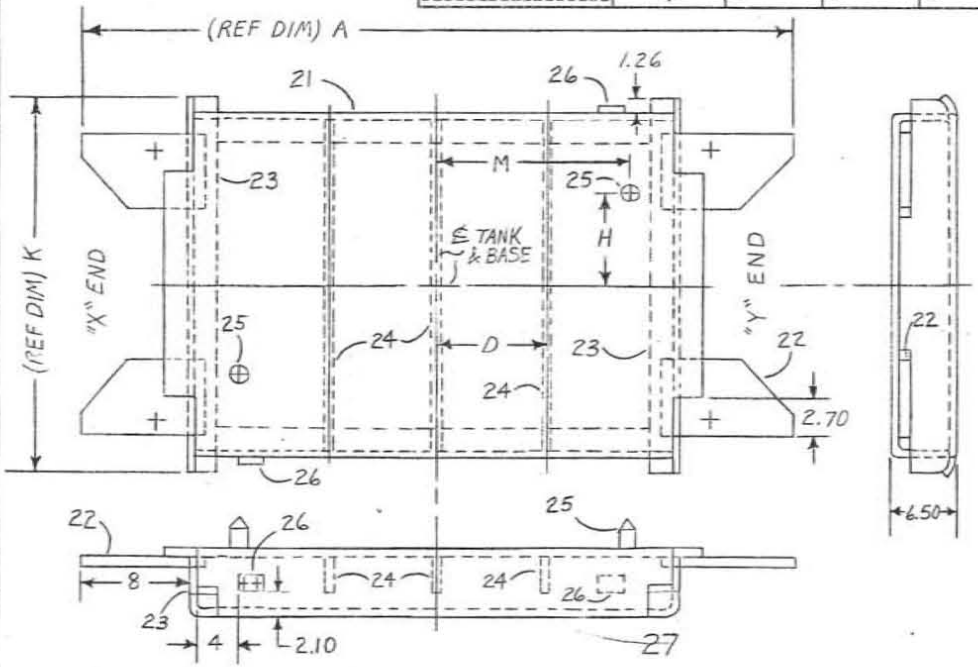
555B102
CONT ON SHEET SH NO.

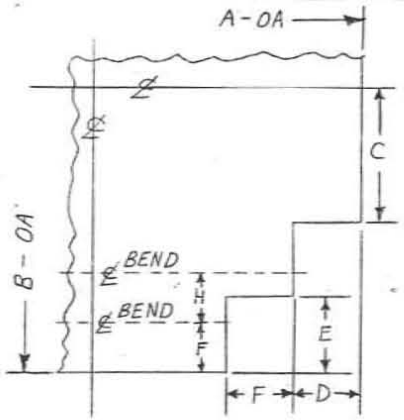
UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING:—

APPLIED PRACTICES	SURFACES	TOLERANCES ON MACHINED DIMENSIONS FRACTIONS	DECIMALS	ANGLES
	✓	±	±	±

REV NO. CONT ON SHEET SH NO.

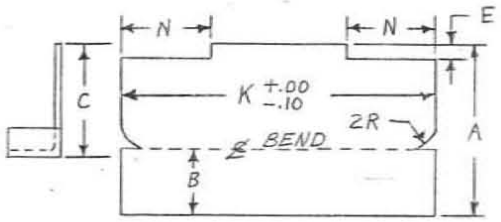
TITLE
BASE
FIRST MADE FOR TRANS 10





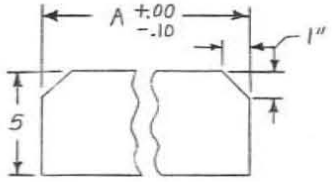
	THK	D	E	F	H
21A	.312	1.80	3.70	2.20	5.88
21B	.375	1.90	4.10	2.60	5.76

STL B4A8B



	THK	A	B	C	E
23A	.312	8	2.20	6.12	SEE PL
23B	.375	8.30	2.60	6.06	1.06

STL B4A8B



24 THK= B
STL B4A8B

4. FOR TAB DIM SEE PL WHERE CALLED FOR
3. WELD TO 744A210 FIG # 8C
2. IF QTY OF RIBS CALLED FOR IS (0), RIB IS ON ℄
IF QTY IS (2) CENTER RIB IS OMITTED
1. SEE 744A111AC FIG # 3

DO NOT CHG WITHOUT C.A.P. APPROVAL

REVISIONS		PRINTS TO	
1	CHG "K" TO A" ON P24 N-3(CAP)-27 OCT 30, 57	1A	
		CAP	
		3 A 4	
		5B B	
		(9)	

MADE BY
ISSUED OCT 2, 1957
APPROVALS
DIV OR DEPT ROME
LOCATION
555B102
CONT ON SHEET SH NO.

COMPUTER DET DWG

P-177-15

PF-806-P (40M) 10-56 PRINTED IN U.S.A.

Exhibit 6

GENERAL ELECTRIC 422C207 SH NO. 1

BASE DATA

FIRST MADE FOR TRANS 1 φ

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING: APPLIED PRACTICES	SURFACES	TOLERANCES ON MACHINED DIMENSIONS: FRACTIONS	DECIMALS	ANGLES
	✓	±	±	±

BASE PARTS LIST SHOULD BE MADE AS SHOWN BELOW

TITLE: BASE

PT NO	NAME OF PART	USED WITH	DESCRIPTION	QTY
21 A	PLATE		*P21A A= B= C=	1
21 B	PLATE		*P21B A= B= C=	1
22	JACK PAD		744A207 P__	4
23 A	ANG		*P23A E= K= N=	2
23 B	ANG		*P23B K= N=	2
24	RIB		*P24 A= B=	
25	BUMP PIN		744A211 P__	2
26	GROUND BLK		755A168 G1	2
27	ASM		*P27 A= K= D= H= M=	X_1

*=555B102

PT NO	INFORMATION REQUIRED FOR ORDERING BASE
21A	USE IF TOTAL WEIGHT OF TRANSFORMER DOES NOT EXCEED 25000#, OTHERWISE OMIT A=INSIDE TANK LENGTH+3 B=INSIDE TANK WIDTH+[2 X BASE EXT]+15.50 C=(.50 X INSIDE TANK WIDTH) + 1.50
21B	USE IF TOTAL WEIGHT OF TRANSFORMER RANGES FROM 25001# THRU 50000# A=INSIDE TANK LENGTH + 3 B=INSIDE TANK WIDTH+[2 X BASE EXT]+16 C=(.50 X INSIDE TANK WIDTH) + 1.50
22	#1 = 744A207 P110 SEE L.O. CHART #2 = 744A207 P108 AT RIGHT
23A	USE WHEN P21A IS REQUIRED, OTHERWISE OMIT E=.70 WHEN JACK PAD #1 IS USED FOR P22 E=1.06 WHEN JACK PAD #2 IS USED FOR P22 K="B" ON P21A -13 N= BASE EXT + 2.50
23B	USE WHEN P21B IS REQUIRED K="B" ON P21B - 13.50 N= BASE EXT + 2.50
24	RIB QTY CALC STRESS USING THE FORMULA: $f = \frac{[P+HC]W^2L^2}{4T^2[W^2+L^2]}$ IF f = 20 000 OR LESS NO RIB IS REQUIRED WHEN f = MORE THAN 20 000 RECALCULATE USING .50 THE VALUE OF L IF f = 20 000 OR LESS (1) RIB IS REQUIRED HOWEVER, IF f = MORE THAN 20 000 RECALC USING .333 THE VALUE OF L. IF f = 20 000 OR LESS (2) RIBS ARE REQUIRED WHEN f = MORE THAN 20 000 SEE MDG SECT
24 CONTD	RIB LENGTH, A A = "B" ON P21A - 16.25, WHEN P21A IS USED A = "B" ON P21B - 16.88, WHEN P21B IS USED RIB THK, B CALC SECT MODULUS USING THE FORMULA: $S = \frac{[P+HC]W^3 L_1}{[L_1+W][160,000]}$ [L_1 = FINAL VALUE OF "L" (.50L OR .333L) USED TO SOLVE FOR "f"] THEN REFER TO CHART BELOW:

PLATE P/NO	SECTION MODULUS	THK OF RIB(S)
P21A	0 - 2.47	.312
	2.48 - 2.92	.375
	OVER 2.92	SEE MDG SECT
P21B	0 - 3.07	.375
	3.08 - 3.98	.500
	OVER 3.98	SEE MDG SECT

ABOVE FORMULAS BASED ON FOLLOWING SYMBOLS:
- T= BASE PLATE THK (IN.)
- H= INSIDE HEIGHT OF TANK (IN.)
- P= TEST PRESSURE (PSI) SEE TABLE #1
- W= TANK WIDTH (IN.)
- L= TANK LENGTH (IN.)
- C= .0322 FOR OIL
  - .0562 FOR PYRANOL

25 & 27

CORE SIZE	BUMPER PIN 744A211 P__	K_1	K_2	WINDOW WIDTH (WW) 8 OR LESS	WINDOW WIDTH (WW) OVER 8	
				M=	M=	H=
9 - 10	21	9	4.20	$K_2 + \frac{WW}{2}$	$K_2 + WW - 2$	$\frac{K_1}{2} + 5.50$
10 - 11	21	10	4.60			
11 - 12	21	11	5.20			
12 - 13	22	12	5.60			
13 - 14.50	22	13	6.30			
15 - 16	23	15	7.13	$K_2 + 5$		
16 - 17.50	22	16	7.83	$K_2 + WW - 2$		

GIVE "D" DIM WHEN (2) RIBS ARE REQUIRED. "D" = .166 X INSIDE TANK LENGTH, ROUNDED OFF TO NEAREST .10 INCREMENT

A= "A" ON P21A OR 21B +13
K= "K" ON P23A OR 23B

LAYOUT NO.	#1=744A207 P110 #2=744A207 P108		LAYOUT NO.	#1=744A207 P110 #2=744A207 P108		LAYOUT NO.	#1=744A207 P110 #2=744A207 P108		LAYOUT NO.	#1=744A207 P110 #2=744A207 P108	
1-2	1		3-22	1		7-3	1		9-28	1	
1-5	1		3-25	1		7-4	1		9-33	2	
1-6	1		3-26	1		7-5	1		9-36	2	
1-13	1		3-27	1		7-7	1		9-37	2	
1-14	1		3-28	1		7-8	1		9-40	2	
1-17	1		3-29	1		7-13	1		11-9	2	
1-18	1		3-30	1		7-15	1		11-12	2	
1-21	1		3-37	1		7-16	1		11-13	2	
1-22	1		3-40	1		7-17	1		11-16	2	
1-25	1		3-41	1		7-19	1		11-17	2	
1-26	1		3-44	1		7-20	1		11-20	2	
1-29	1		5-1	1		7-25	1		11-33	2	
1-30	1		5-3	1		7-27	1		11-36	2	
1-41	1		5-4	1		7-28	1		11-37	2	
1-42	1		5-5	1		7-37	1		11-40	2	
3-2	1		5-7	1		7-40	1		13-17	2	
3-3	1		5-8	1		9-1	1		13-20	2	
3-4	1		5-13	1		9-3	1		13-33	2	
3-5	1		5-15	1		9-4	1		13-36	2	
3-6	1		5-16	1		9-5	1		13-37	2	
3-7	1		5-17	1		9-7	1		13-40	2	
3-8	1		5-19	1		9-8	1				
3-13	1		5-20	1		9-9	1				
3-14	1		5-25	1		9-11	1				
3-15	1		5-27	1		9-12	1				
3-16	1		5-28	1		9-13	1				
3-17	1		5-37	1		9-15	1				
3-18	1		5-40	1		9-16	1				
3-19	1		5-41	1		9-17	1				
3-20	1		5-44	1		9-20	1				
3-21	1		7-1	1		9-25	1				

INFORMATION REQUIRED TO USE THIS DWG:
1. TOTAL WEIGHT
2. LAYOUT NO.
3. INSIDE TANK DIMENSIONS - HEIGHT, WIDTH, & LENGTH
4. BASE EXTENSION - INSIDE OF TANK OVER BASE PLATE
5. OIL OR PYRANOL?
6. OPER. & VACUUM PRESS.
7. CORE SIZE & WINDOW WIDTH

INFORMATION REQUIRED FROM ENG
1. INSIDE TANK DIMENSIONS - HEIGHT, WIDTH, & LENGTH.
2. OIL OR PYRANOL?
3. CORE SIZE & WINDOW WIDTH
4. LAYOUT NO.
5. OPER. & VACUUM PRESS.
6. TOTAL WEIGHT

TABLE #1

OPER	PRESS. VAC	TEST
3	5	4.50
3	FULL	15
5	5	6.50
7.50	FULL	15
5	5	6.50
7.50	5	9
7.50	FULL	15

REVISIONS
1. CHG "K" TO "A" ON P24, "A" SYMBOL TO "C" IN FORMULAE — N-3(CAP)-27 [illegible]
2. CHG L TO L_1, P24 SECT MODULUS FORMULA & ADD NOTE (L_1) — N-3(70)-24 [illegible]
3. ADD DATA TO L.O. CHART, IN P24 CHG PL SIZE TO P NO IN SECT MOD CHART — N-15-27 [illegible]
4. N-15-27 [illegible]
5. GEN CHG — CHG "B" P23A [illegible]
6. CHG P26 P21 P24 [illegible]

DUPLICATE STDS. GR. IF CHGD. 1 PR. C.A.P.

DO NOT CHG. WITHOUT C.A.P. APPROVAL

PRINTS TO: IA, CAP ONLY

MADE BY [illegible] Oct 7, 1957
ISSUED [illegible] Oct 21, 57
LOCATION ROME

422C207 SH NO. 1

P-177-15

COMPUTER DWG.

Exhibit 7

▲ Col. 1

GENERAL ELECTRIC ROME

FIRST MADE FOR TRANS.

TITLE: END INS

JN21-862650

PARTS LIST: 426L425BE G1

▲ JOB NO. & QUAN.: 21-862650

PARTS LIST: 426L425BE G1

GROUP | ISS | SHEET 1

PLANNED BY EDPM | COSTED BY

REVISIONS	PT.	NAME OF PART	USED WITH	DESCRIPTION	QUAN.	COSTS
	301	COLLAR		*P301 B=23.50 D=12 V=11.51 E=3.20 F= 8.05	2	.125 X 12.00ID X 23.50 M01E 5.5/ 2.7 02J 6.0/ 5.3 3J 2.0/ 4.9
	303	SPACER		.250R X 1.50 X 2 (L)	22	.250 X 1.50 X 2 M03J 3.0/ .8
	304	SPACER		.250R X 1.50 X 2.80	12	.250 X 1.50 X 2.80 M03J .2/ .4
	305	SPACER		.250R X 1.50 X 3.38	22	.250 X 1.50 X 3.38 M03J .2/ .8
	306	SPACER		.125R X 2.50 X 5.30	2	.125 X 2.50 X 5.30 M01E .5/ .2
	307	ANGLE		*P307 L= 5.30	2	.125 X 4.20 X 5.30 M01E .5/ .2 02J 2.0/ .3 04J 2.0/ 1.3
	308	ANGLE ASM		*P308	X2	M05J .2/ 3.9
	311	COLLAR ASM (BOT)		ASM (1)301 Y=8.24 (8)304 R=5.86 (14)303 W=1.58 (14)305 (2)308 TO *P311	X1	M02J / 1.3 05J 11.7/11.5
	312	COLLAR ASM (TOP)		ASM (1)301 Y=8.24 (4)304 (8)303 (8)305 TO *P312	X1	M02J / 1.3 05J 3.3/ 5.5
	315	BARRIER		.156 X 17.20 X 33.50	2	.156 X 17.20 X 33.50 M01E .5/ 3.7 05J / 1.8
	316	ANGLE BARR		*P316 A=23.50 B=16.75 C=8.60 D=11.48 E=29.15	2	.094 X 23.50 X 29.15 M01E .5/ 3.9 02J 2.0/ 8.5 3J 2.0/ 7.7 04J 2.0/ 2.6 5J / 1.6
	317	U-SPACER		744A970MAP100A B=.10 A=2.78 D=5.66	8	.100 X 1.50 X 5.66 M01E .5/ 1.6 / 6.4 13.0/ 6.4
	318	U-SPACER		744A970MAP100A B=.10 A=3.38 D=6.86	16	.100 X 1.50 X 6.86 M01E .5/ 1.6 / 6.4 / 6.4
	319	ANGLE BARR ASM		*P319	X2	PLANNED BY ASM. AREA PLANNING
	321	FLANGED COLLAR		744A970FB P21	2	M.O. BOOK ISSUED
	322	COLLAR		744A970PA P2 A=11.51 THK= .125 ID=19.80 OD=23.50	2	.125 X 19.80ID X 23.50OD M01E 1.0/ 1.8 02J 2.0/ 4.0 3J 1.0/ 1.7
	REV. NO.	* 378D710B8		FOR MATL. SEE 744A227		

WEIGHTS
MAT. TOTAL | LABOR TOTAL
CORR. TOTAL | CORR. TOTAL

MT-952A

MADE BY EDPM 2- 5-59 ISS. BY EDPM | PRINTS TO | CONT. ON SH. 2

Exhibit 8, Sht. 1

GENERAL ELECTRIC

ROME

FIRST MADE FOR TRANS.

TITLE: END INS

JN 21-862650

PARTS LIST: 426L425BE G1

▲ JOB NO. & QUAN.: 21-862650

PARTS LIST: 426L425BE G1

GROUP | ISS | SHEET 2

PLANNED BY EDPM | COSTED BY

REVISIONS

PT.	NAME OF PART	USED WITH	DESCRIPTION	QUAN.
323	COLLAR		744A970PA P2 A=11.51 THK= .125 ID=16.50 OD=23.50	2
325	COLLAR ASM		*P325	X2
326	END INS ASM		*P326	X1

COSTS

.125 X 16.50ID X 23.500D

M01E 1.0/ 1.8 02J 2.0/ 4.0

3J 1.0/ 1.7

M05J / 1.8

PLANNED BY ASM. AREA PLANNING

REV. NO. * 378D710BB FOR MATL. SEE 744A227

MT-952A

MADE BY EDPM 2- 5-59 ISS. BY EDPM

PRINTS TO

CONT. ON SH.

WEIGHTS

MAT. TOTAL | LABOR TOTAL

CORR. TOTAL | CORR. TOTAL

Exhibit 8, Sht. 2

Exhibit 9, Sht. 1

QUAN. ORDERED	QUAN. COMP.	JOB NUMBER	START DATE	FINISH DATE	PLAN'R	PLANNED DATE	SEC.	INSPECTOR	BOOK	REV.	CFO	PL	GROUP	PART
2		23S128448	00000050	CAP	41595	1		1 OF 1	00	379L505	DS	G253D		

MATERIAL SILECTRON STEEL 750 KVA CORE WT.= 1921

DATE	NAME OF OPERATOR	GR/PAY NUMBER	ROUTING	NAME OF PART	REV.	DRAWING NO.	GROUP	PART
			51 420 52	CORE	00			

OP	WK STN.	B	SU	TIME	R	OPERATIONS	CU WGHT DATE	WT INCH	PRICE	COST PER MATERIAL	COST PER LABOR
01	5102	S	01233	00643	H	BLOCK TO SIZE					
02	5104	S	00960	01233	F	CONTINUOUS ANNEAL					

MASTER

MOVE CARD

JOB RECORD

OPER 1

OPER 2

I.D. TAG

WORK SHEET

Exhibit 9, Sht. 2

JN 31-127448A-B | SETS | DWG NO 426L491BE G-1

TITLE END INSULATION

PT NO	PCS PER SET	SHEAR SU / SET	L/O SU / SET	SAW SU / SET	BEND SU / SET	ASM. SU / SET	MOLD SU / SET	SU / SET	SU / SET	REFERENCE DRAWING	MATERIAL
301	1	5.5 / 1.4	6. / 5.3	2. / 4.9						* PT. 301	.125 X 16 X 22.0 OD
301A	1	.5 / 1.4	2. / 5.3	2. / 4.9						* PT. 301	.125 X 16 X 22.0 OD
303	22			3. / .8							.250 X 1.50 X 2.0
304	12			.2 / .9							.250 X 1.50 X 2.52
305	22			.2 / .9							.250 X 1.50 X 3.14
306	2	.5 / .2									.125 X 2.50 X 5.00
307	2	.5 / .2	2. / 3.		1. / 4.					* 307	.125 X 4.20 X 5.00
308	2					.2 / 2.9				* PT. 308	
311	1		1.3			11.7 / 11.5				* PT. 311	
312	1		1.3 / 1.			3. / 7.0				* PT. 312	
315	2	.5 / 2.1				1.8					.156 X 16.20 X 40.50
316	2	.5 / 2.	2. / 8.5	2. / 7.7	2. / 2.6	1.6				* PT. 316	.094 X 22.00 X 27.47
317	8	.5 / 1.3					13. / 5.6			** MA PT.100A	.100 X 1.50 X 5.10
318	16	.5 / 1.6					6.4				.100 X 1.50 X 6.34
322	2	1. / 2.8	2. / 4.	1. / 1.7						** PA PT. 2	.125 X 19.00 OD X 22.00 OD
323	2	1. / 2.8	2. / 4.	1. / 1.7							.125 X 15.50 ID X 22.00 OD
325	2				1.8						
321		FLANGED COLLAR F. B. PT. 21									
											* 378D710BB ** 744A970

* 378D710BB
** 744A970

EXHIBIT 10

Col. 1

GENERAL ELECTRIC
ROME

TITLE
PUNCH SHEET LV

PARTS LIST
422C205AA P 164

FIRST MADE FOR TRANS.

JN 21-863617

GROUP | ISS | SHEET 1

REVISIONS	PT.	NAME OF PART	USED WITH	DESCRIPTION X	DESCRIPTION Y	QUAN.
		STATION .250 X 79.50 X 111.25				
		1		34.38	109.75	
		1		37.62	109.75	
		7		36	108.31	
		1		72.88	109.75	
		1		76.12	109.75	
		7		74.50	108.31	
		9		77.30	99.50	
		9		71.70	99.50	
		9		65.12	99.50	
		9		58.54	99.50	
		9		51.96	99.50	
		9		45.38	99.50	
		9		38.80	99.50	
		9		33.20	99.50	
		9		24.50	99.50	
		9		6.50	99.50	
		7		12	104.75	
		7		19	104.75	
		7		15.50	104.75	
		7		12	90.75	
		7		19	90.75	
		7		15.50	90.75	
		1		10.69	102.19	
		1		10.69	98.19	
		1		10.69	94.19	
		1		20.31	102.19	
		1		20.31	98.19	
		1		20.31	94.19	
		15B TURN PLATE	180	15.50 DEGREES	76	
		SET X SCALE AT		79.50		
		SET Y SCALE AT		51.25		
		9		2.20	102.75	
		9		7.80	102.75	
		9		14.38	102.75	
		9		20.96	102.75	
		9		27.54	102.75	
		9		34.12	102.75	
		9		40.70	102.75	
		9		46.30	102.75	
		9		55	102.75	
		9		73	102.75	
		9		64	110.37	

REV. NO.

4T-952C

MADE BY DO NOT ISSUE ISS. BY NOT

PRINTS TO 3A4, 3B1,

TOTAL 5 COL CONT. ON SH.

Exhibit 11

OPERATION VOUCHER

DRAWING NO. | GR | PT | ITEM | JOB NO OR SSO | QUAN | OP | R | STATION | B | SU | SET UP | TIME

112A1605 3 29 21 869999 0001 02 L 6370 4 S 0006 3 0011 3

DRAWING NO. | GR | PT | ITEM | JOB NO OR SSO | QUAN | OP | R | STATION | B | SET UP | TIME

0 OUTLINE SPEC
1 ...OR ... JCHL
2 FLOOR STOCK
3 MANF'D ITEM
4 ASSEMBLY STATISTICS
5 OUTSIDE VENDOR
6 STOCK
7 COST DATA
8 INCOMPL. COST
9 INCOMPL. PLANNING

NO PUNCH IN COL.2 INDICATES DRAFTING STATISTICS CAR.

FOR WIRE ONLY

DISPATCHER: MARK SENSE ONE OF THE SU VALUES OPPOSITE NO OF PASSES

PASSES
1 8.0 24.0
2 16.0 24.5 39.5
3 21.0 38.0 53.0
4 25.0 50.0 60.0

A CARD

IMPORTANT:

MARK ONE OR OTHER OF THESE 2 BLOCKS

SU NOT APPROVED — 8 COL 70

SU APPROVED — 9 COL 70

QUANTITY COMPL.

PAY OR GROUP NO

DATE

OPERATORS SIGNATURE

CODE FOR "B" — COL 69

S = STD
T = TEMP
Y = SPL
Z = DAY WORK
E = ESTIMATE

QUAN. ORDERED | QUAN. WITHD.

QUANTITY — PAY OR GR. NO.

COMPLETED OR WITHDRAWN

FOR WITHDRAWAL ONLY "0" COL. 2 | UNIT OF MEAS

FORMAT

DRAWING NO. | GR | PT | DATE | ORDERING STOCK ROOM | ITEM OR STD.COST | PAY OR GR NO | QUAN. COMPL. | JOB NO OR SSO | QUAN ORDERED | OP | R | STATION | B | SU APP | SET UP | TIME

MT-989 B GENERAL ELECTRIC CO. ROME, GA. IBM D13051

EXTRA WORK VOUCHER

F | ITEM OR DWG NO. | GR. NO. | PT. NO. | I.R. NO. | T V | SECT. AT FAULT | REA. | B | PAY OR GR. NO. | QUAN. COMPL. | WEEK NO. | JOB OR ACCOUNT NO. | QUAN. ORDER'D | OP | R | WORK STA. | B | SU | SET UP | TIME OR MONEY

X COL. 80 = MONEY
NO X " " = MINUTES
X COL. 75 = DO NOT PAY
X COL. 76 = CREDIT

NAME OF PART

CHECK ONE
- CONTINUATION X DL
- REWORK 0 EXP
- EXTRA COST 1 EXP
- DAY WORK 2 DL
- ADDITIONAL PLANNING 3 DL
- PIECE WORK DAY WORK 4 DL
- LOST PARTS 5 DL
- IDLE TIME 6 EXP
- ALL OTHER EXPENSE 7
- DAY WORK 8 EXP
- MAKE UP TIME EXP 9

OPERATOR'S SIGNATURE | PLANNER'S APPROVAL | FOREMAN'S APPROVAL

40 QUAN COMPL. | 44 WEEK NO.

1 | 2 | 3 ITEM NO. OR DRAWING NO. | 13 GROUP NO. | 16 PART NO.

46 JOB NO. OR ACCOUNT NO. | 57 QUAN. ORDERED

22 I.R. NO. | 28 TYPE VOUCHER SEE COL. 39 | 29 SECT. AT FAULT | 32 REASON NO. | 34 1=ACR 2=GUAR. R 3=JOB R. | 35 PAY OR GR. NO.

61 OPER. NO. | 63 RATE SYM. | 64 WORK STATION | 69 BASIS OF PAYM'T | 70 SU. APPROVAL "9" COL. 70 = YES (SIGNED) "8" " " = NO

B CARD

IBM G29674-S

DESCRIPTION OF OPERATION — MATERIAL REQUIRED

71 SET UP | 75 76 MINUTES OR $ — X COL. 75 = DO NOT PAY — X COL. 80 = $

INDICATE TYPE OF EXPENSE HERE

WORK DONE ON MACHINE NO.

FORMAT | ITEM NO. OR DRAWING NO. | GR. NO. | PT. NO. | I.R. NO. | T V | SECT. FAULT | REAS. NO. | B | PAY OR GR. NO. | QUAN. COMPL. | WK. NO. | JOB OR ACCOUNT NO. | QUAN. ORDER'D | OP NO. | R SYM | WORK STATION | BASIS | SU APP | SET UP | TIME OR $

MT 990C GENERAL ELECTRIC CO. ROME GA.

COMPUTER INPUT COPY
3 ADDITIONAL COPIES (4 PART FORM)
1 SECTION COPY
1 COST COPY
1 OPERATORS COPY

GENERAL ELECTRIC
ROME

MADE BY Miller 5/8/59
ISSUED S. Schwimmer

TITLE 1Φ END INSULATION FLOW CHART

27BHB344WF
CONT. ON SHEET 2 SH. NO. 1

REV

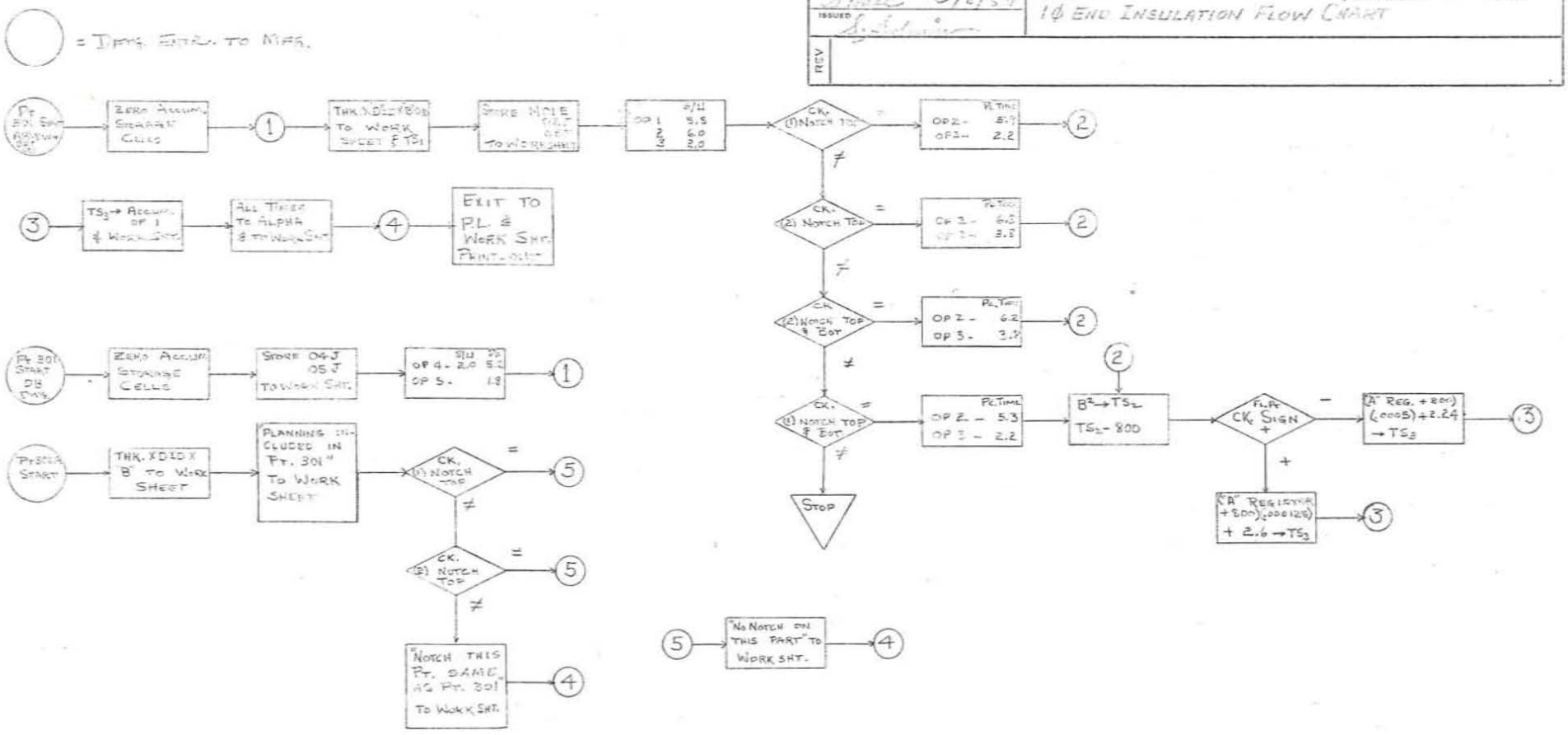


Exhibit 12, Sht. 1

FORMULA NO. 24 - 5AT - IN - 5
JOB CLASS. 7700
JOB RATE SYM. R-16
EFFECTIVE DATE 3/19/56
SHEET 1 OF 4

REVISION #1 - EFFECTIVE 7-28-59

OPERATION: ASSEMBLY
NAME OF PART: CLAMP, END AND MISC. INSULATION
TYPE OF APPARATUS: MEDIUM POWER TRANSFORMERS
MATERIAL USED: PRESSBOARD

LIMITATIONS OF FORMULA

THIS FORMULA COVERS THE ASSEMBLY OF CLAMP INSULATION, END INSULATION AND MISCELLANEOUS SUB-ASSEMBLIES. INCLUDED ALSO IS THE LAMINATING OF ANGLE BARRIERS AND ASSEMBLING SUB-ASSEMBLIES TO CLAMP INSULATION. ALL PARTS ARE LAID OUT AND MARKED GIVING THE SPECIFIC LOCATION AND WHAT PART IS TO BE ASSEMBLED THERE.

FOR THE PURPOSE OF THIS FORMULA, END INSULATION HAS BEEN DEFINED AS ANGLE BARRIERS AND COLLARS. CLAMP INSULATION IS DEFINED AS THE TOP AND BOTTOM CLAMP INSULATION AND PROTECTION PIECES.

JOB OPERATION

THE VALUES IN THE FOLLOWING CHARTS ARE BASE VALUES WITH 7% ALLOWANCES ADDED. THE ALLOWANCES ARE:

NORMAL REST AND DELAY	6%
CLEAN WORK STATIONS	1%
TOTAL	7%

THE ALLOWANCES WERE ADDED TO THE BASE VALUES IN THE FOLLOWING MANNER:

CHART "A" - CLAMP INSULATION AND LOAD CENTERS - 3.866 X 1.07 = 4.13662 ADJUSTED TO 4. MIN.
CHART "B" - PER PIECE, ASM. ONE SIDE ONLY - 1.7529 X 1.07 = 1.875603 ADJUSTED TO 1.9 MIN.
CHART "C" - ASM. ONE SPACER - .2215 X 1.07 = .237005 ADJUSTED TO .24 MIN.

CHART A - SET-UP PER JOB NO.

CLAMP INSULATION AND LOAD CENTERS		4. MIN.
END INSULATION, ON OR OFF CENTER ASM.		6. MIN.
FOR EACH PART HAVING A DIFFERENT I.D.	ADD	1. MIN.
END INSULATION REQUIRING BOTH ON AND OFF CTR. ASM.		12. MIN.
FOR EACH PART HAVING A DIFFERENT I.D.	ADD	6. MIN.

CHART B - ASM. END INSULATION - ALLOWED HANDLING TIME

PER PIECE - ASM. ONE SIDE ONLY	EACH	.95 MIN. EA.
PER PIECE - ASM. BOTH SIDES		1.2 MIN. EA.
ASM. ONE SPACER		.26 MIN. EA.
LAMINATE ANGLE BARRIER	EACH	.9 MIN. EA.
PER PT. NO. - FOR PARTS REQUIRING DRILL OR SAW		.5 MIN.
PER PT. NO. - FOR EACH SPACER ON ONE PIECE (PER PT. NO. ONLY ADD)		.15 MIN.
PER PT. NO. - TIE AND TAG		.80 MIN.

FORMULA NO. 24 - 5AT - IN - 5
JOB CLASS 7700
JOB RATE SYM. R-16
EFFECTIVE DATE 3/19/56
SHEET 2 OF 4

REVISION #1 - EFFECTIVE 7-28-59

JOB OPERATION (CONT'D)

CHART C - ASM. CLAMP INSULATION		
PER PIECE, ASM. ONE SIDE ONLY	EACH	.42 MIN.
PER PIECE, ASM. BOTH SIDES	EACH	.65 MIN.
ASM. ONE SPACER		.24 MIN.
ASM. SUB-ASSEMBLY TO CLAMP INS.		.8 MIN.
PER PT. NO. - FOR PARTS REQUIRING SAW OR DRILL		.5 MIN.
PER PT. NO. - FOR EACH SPACER ON ONE PIECE PER PT. NO. ONLY		.15 MIN.
PER PT. NO. - TIE AND TAG		.80 MIN.

CHART D - ASM. MISC. INSULATION AND HANDLE PTS. REQUIRING NO ASM.		
PER PIECE, ASM. MISC. INS. ON ONE SIDE ONLY	EACH	.32 MIN.
PER PIECE, ASM. BOTH SIDES	EACH	.54 MIN.
ASM. ONE PRESSBOARD SPACER		.27 MIN.
ASM. ONE WOOD SPACER		.38 MIN.
PER PT. NO. - FOR PARTS REQUIRING SAW AND DRILL		.5 MIN.
PER PT. NO. - FOR EACH SPACER ONE PIECE PER PT. NO. ONLY		.15 MIN.
PER PT. NO. - HANDLE PARTS THAT REQUIRE NO ASM.		1.1 MIN.
PER PT. NO. - MARK AND POSITION TAG (PARTS THAT ARE NOT ASM.)		.4 MIN.
PER PT. NO. - TIE AND POSITION TAG		.80 MIN.

EXAMPLE OF PLANNING

CLAMPS: THE S/U PER JN FOR ASM. CL. INS. IS OBTAINED FROM CHART A.

FROM CHART C, THE VALUE FOR ASM. 1 SPACER SHOULD BE MULTIPLIED BY THE NUMBER OF SPACERS REQUIRED. IF THE SPACERS ARE ASSEMBLED ON BOTH SIDES OF THE CLAMP INS. THE VALUE NOTED AS SUCH SHOULD BE GIVEN PER PIECE. THE VALUES USED PER PT. NO. SHOULD BE APPLIED TO CYCLE TIME. IF MORE THAN 1 PT. IS INVOLVED PER PT. NO. AND HAS UNDERGONE A STACKING OPERATION, THE VALUE .5 MIN. IS GIVEN PER PT. NO. AFTER ALL THE PIECES FOR 1 PT. NO. HAVE BEEN ASSEMBLED THE OPERATOR PLACES A WEIGHT ON THE TOP PIECE, 1 WEIGHT COVERING 2 SPACERS. THEREFORE, THE NUMBER OF SPACERS X .15 GIVES THE PRESS TIME FOR 1 PT. NO.

IN ORDER TO FACILITATE PLANNING VARIOUS ELEMENTS IN THE PRECEDING CHARTS WERE COMBINED WHERE PRACTICAL.

FORMULA NO. 24 - 5AT - IN - 5
JOB CLASS 7700
JOB RATE SYMBOL R-16
EFFECTIVE DATE 3/19/56
SHEET 3 OF 4

REVISION #1 - EFFECTIVE 7-28-59

CHART "A" - SET-UP PER JOB NO.

CLAMP INSULATION AND LOAD CENTERS		4. MIN.
END INSULATION, ON OR OFF CENTER ASM.		6. MIN.
FOR EACH PART HAVING A DIFFERENT I.D.	ADD	1. MIN.
END INSULATION REQUIRING BOTH ON AND OFF CENTER ASM.		12. MIN.
FOR EACH PART HAVING A DIFFERENT I.D.	ADD	6. MIN.

CHART "B" - ASM. SPACERS TO CLAMP, END AND MISC. INSULATION

SPACERS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
MIN.	.25	.50	.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	2.75	3.0	3.25	3.5	3.75	4.0
S/U PER PT. NO.	.15	.30	.45	.60	.75	.90	1.05	1.20	1.35	1.50	1.65	1.80	1.95	2.10	2.25	2.40

CHART "B" - CONTINUED

SPACERS	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
MIN.	4.25	4.5	4.75	5.0	5.25	5.5	5.75	6.0	6.25	6.5	6.75	7.0	7.25	7.5	7.75	8.0
S/U PER PT. NO.	2.55	2.70	2.85	3.0	3.15	3.30	3.45	3.60	3.75	3.90	4.05	4.20	4.35	4.50	4.65	4.80

CHART "B" - CONTINUED

SPACERS	33	34	35	36	37	38	39	40	41	42	43	44	45	46
MIN.	8.25	8.5	8.75	9.0	9.25	9.5	9.75	10.0	10.25	10.5	10.75	11.0	11.25	11.5
S/U PER PT. NO.	4.95	5.10	5.25	5.40	5.55	5.70	5.85	6.0	6.15	6.30	6.45	6.60	6.75	6.90

CHART "B" - CONTINUED

SPACERS	47	48	49	50
MIN.	11.75	12.0	12.25	12.5
S/U PER PT. NO.	7.05	7.20	7.35	7.50

NOTE: ADD .8 MIN. TO EACH PART NUMBER FOR TYING AND TAGGING.

CHART "C" - HANDLE END INSULATION

PER PIECE	ASM. ONLY	EACH	.95 MIN.
LAMINATE ANGLE BARRIERS			.9 MIN.

CHART "D" ASM. CLAMP INSULATION

PER PIECE	ASM. ONLY	EACH	.42 MIN.
ASM. SUB-ASM. TO CLAMP INSULATION			.8 MIN.

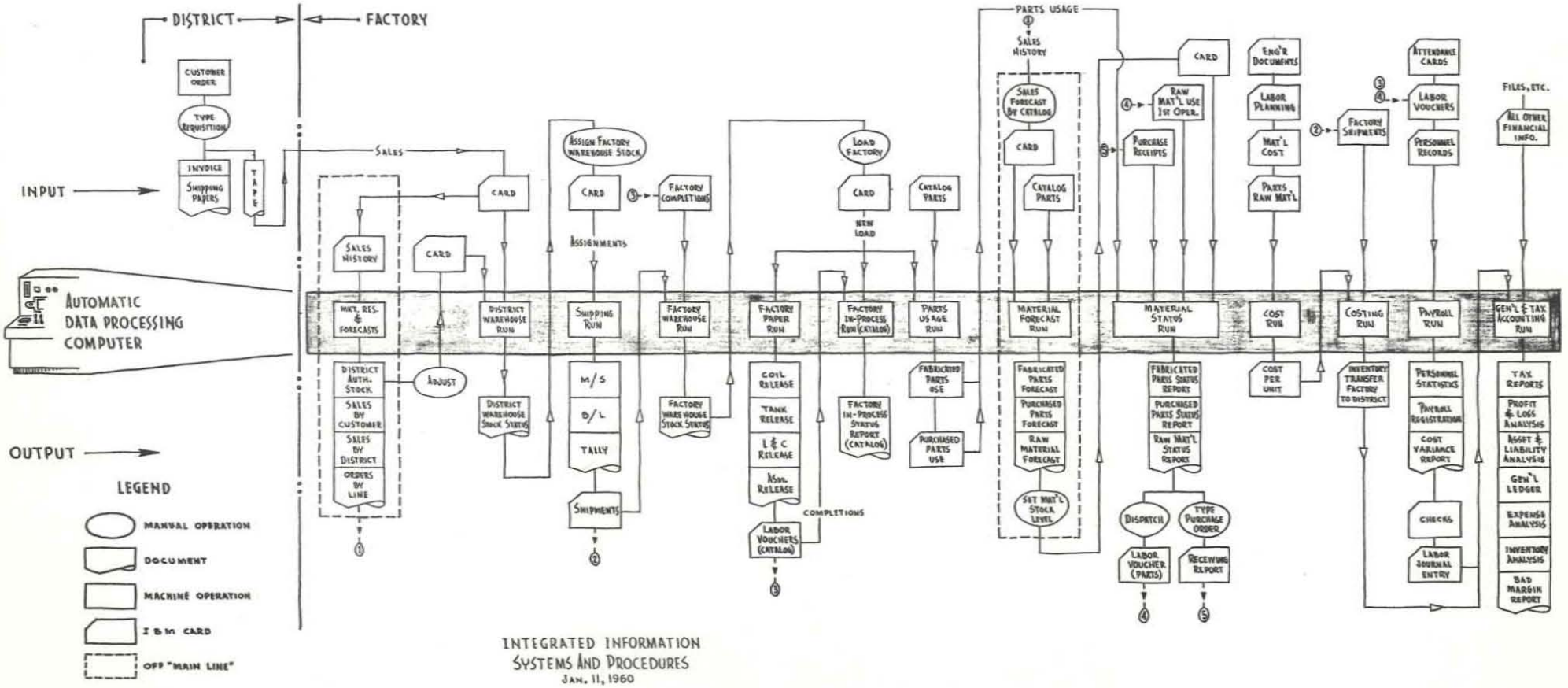
CHART "E" - ASM. MISC. INSULATION

PER PIECE	.32 MIN.
ASM. WOOD SPACER	.4 MIN.

CHART "F" - APPLY WITH LAST OPERATION

FOR PARTS REQUIRING DRILL, SAW, OR BEND (REQUIRING NO ASM.) PER PT. NO.	1.5 MIN.

DISTRIBUTION TRANSFORMER DEPARTMENT
DATA PROCESSING SYSTEM
(POLE TYPE)



INTEGRATED INFORMATION
SYSTEMS AND PROCEDURES
JAN. 11, 1960

Exhibit 13

PURCHASE ORDER

RECEIVING SECTION COPY

PURCHASE ORDER

SHIP TO
VIA CHEAPEST WAY

GENERAL ELECTRIC

MEDIUM TRANSFORMER DEPT.
REDMOND CIRCLE, ROME, GA.

- NO PARCEL POST INSURANCE CHARGES WILL BE ALLOWED UNLESS AUTHORIZED BY PURCHASER.
- PACKING SLIPS OR CONTENTS LABELS MUST IDENTIFY EACH CARTON OR SEPARATE ITEM OF ALL SHIPMENTS.
- RENDER INVOICES IN TRIPLICATE ACCOMPANIED BY SHIPPING RECEIPTS.

Date of Order	Please Acknowledge By	Ship On	MARK ONLY ON PACKAGES	ST RM	MARK PACKAGES & DOCUMENTS WITH
MO. DAY YR.	MO. DAY YR.	MO. DAY YR.	ADDRESS ALL DOCUMENTS TO	B/C	ACCOUNT NO. ORDER NUMBER 086- SUBJ. TO GA. SALES AND USE TAX REQ. NO. 200-52-0300 YES NO

ITEM	QUANTITY	U/M	IDENTITY

EXPEDITE

A | VENDOR | DATE ORD. | ACK. BY | SHIP ON | STK RM | ITEM NO. ORDER NO. | B | I | QUAN. ORDERED | MEAS | IDENTITY | PROM | EXTENS'N | QUAN SHIPPED | SHIPPED | M | A | F

PROMISE | EXTENSION | QUAN SHIPPED | SHIPPED | METHOD | ACKNOWLEDGED

ACKNOWLEDGE: 1 CK; 2 RAIL; 3 TRUCK; 4 RAIL EXP; 5 AIR EXP; 6 PP; 7 BUS

DATE SHIPPED →
QUANTITY SHIPPED →

A | VENDOR | DATE ORD. | ACK. BY | SHIP ON | STK RM | ITEM NO. ORDER NO. | B | I | QUAN. ORDERED | MEAS | IDENTITY | QUANTITY REC'D | DATE REC'D | F

A | VENDOR | DATE ORD. | ACK. BY | SHIP ON | STK RM | ITEM NO. ORDER NO. | B | I | QUAN. ORDERED | MEAS | IDENTITY

ACTIVITY CODE

← QUANTITY REC'D → 4 → ← DATE REC'D →

MATERIAL ARRIVAL

PARTIAL ☐ COMPLETE ☐

PREPAID ☐ COLLECT ☐

CARRIER

RECEIVED BY

VENDOR CODE	DATE OF ORDER	ACKNOWLEDGE BY	SHIP ON	STOCK ROOM	ITEM CODE AND ORDER NO.	BUYER	ITEM	QUANTITY ORDERED	UNIT OF MEAS	IDENTITY	QUANTITY RECEIVED		DATE REC'D.				
1 2 3 4 5 6 7	8 9 10 11 12 13	14 15 16 17 18 19	20 21 22 23 24 25	26 27 28	29 30 31 32 33 34 35 36 37	38	39	40 41 42 43 44 45 46	47 48	49 50 51 52 53 54 55 56 57 58	59 60 61 62 63 64 65	66	67 68 69 70 71	72	73	74	75 76 77 78 79 80

GENERAL ELECTRIC CO., ROME, GEORGIA GLOBE 400220

TBM 914206

CO., ROME, GEORGIA